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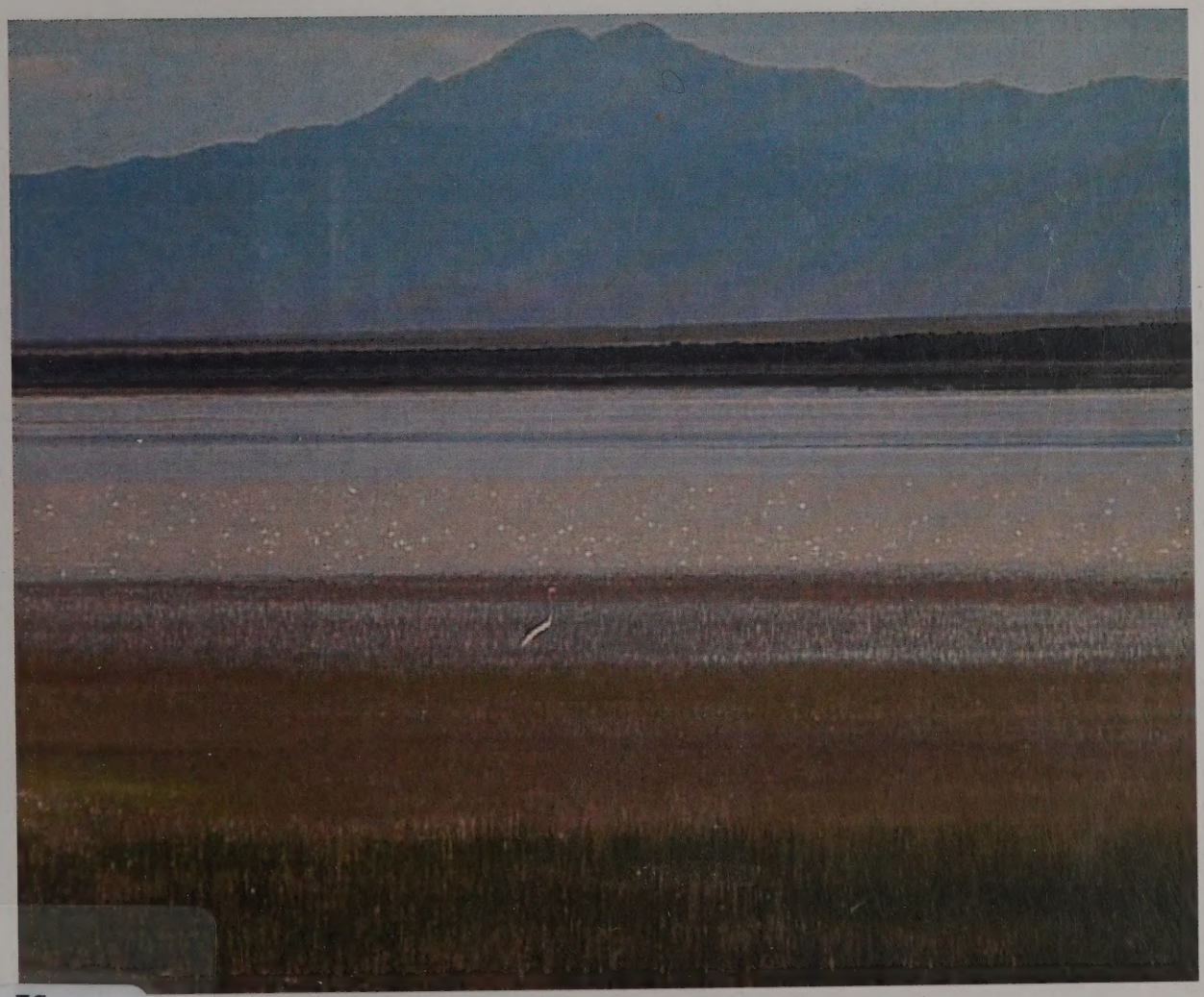
# Surface Water Analysis and Management Recommendations for the Carico Lake Allotment



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## Mission Statement

The Bureau of Land Management is responsible for stewardship of our public lands. The BLM is committed to manage, protect and improve these lands in a manner to serve the needs of the American people. Management is based upon the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation, rangelands, timber, minerals, watershed, fish and wildlife habitat, wilderness, air and scenic quality, as well as scientific and cultural values.

## Acknowledgments

The authors would like to thank the following individuals for the time they offered in review, comment and development of this document: Jeffrey Weeks, George Wingate, Bill Brookes, Duane Crimmins and Bill Lutjens from the Bureau of Land Management; Tom Nash from the U.S. Geological Survey.

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**Bureau of Land Management**
**Battle Mountain Field Office**
**50 Bastian Road**
**Battle Mountain, Nevada 89820**

April 13, 2000

Dear Reader:

Enclosed for your information is a copy of the Surface Water Analysis and Management Recommendations for the Carico Lake Allotment. This study was funded by the Clean Water Action Plan in order to provide data for the Carico Lake Evaluation. This water quality sampling plan for surface water resources provides baseline data to analyze the effectiveness of future best management practices (BMPs).

The Results and Discussion section of this paper presents the water quality and physical condition of select sites throughout the allotment. The cumulative effects of grazing on watersheds are also discussed. The Management Objectives and Best Management Practices section addresses generalized improvements and BMPs that could be used to improve conditions of areas to meet Rangeland Health Standards for the Northeastern Great Basin Resource Advisory Council (RAC) area.

This study will be used in designing site specific BMP's to improve the overall health of watersheds. These will be identified in allotment evaluation plans and implemented in future permit renewals and other land use authorizations.

Additional analyses of water quality and assessment of proper functioning condition in the Carico Lake Allotment will be conducted during the FY 2000 field season.

Sincerely,

Jeffrey A. Weeks

Jeffrey A. Weeks
Assistant Field Manager
Renewable Resources

# Surface Water Analysis and Management Recommendations for the Carico Lake Allotment

by

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## ABSTRACT

In 1999, the Battle Mountain Field Office, Bureau of Land Management, in Nevada, utilized Clean Water Action Plan directed funds to conduct a baseline water quality analysis of the 563,000 acre Carico Lake allotment (second largest in the district). This study provided objective data to evaluate the effectiveness of Best Management practices (BMPs) and assesses compliance with Nevada Department of Environmental Protection (NDEP) water quality standards. Field parameters including dissolved oxygen, specific conductance, water temperature, salinity, and pH were measured using EPA certified equipment. Grab samples were collected following Standard Methods for laboratory analyses of turbidity, nitrate nitrogen, nitrite nitrogen, ammonia nitrogen, total phosphorous and various metals by Acculabs, an EPA certified laboratory in Sparks, Nevada. In addition, samples were analyzed for fecal coliform bacteria by Sierra Pacific Power Co.'s EPA certified lab in Reno, Nevada. Where adequate stream flows were present, discharge was measured in cubic feet per second (cfs). Turbidity and fecal coliform levels did not meet NDEP's water quality standards for Class B waters at 52 percent (15 of 29) of springs and 50 percent (6 of 12) of streams monitored. Management prescriptions for restoration of riparian plant communities, channel morphology and surface water flows are identified. These recommendations are key in meeting or exceeding water quality standards.


## SUMMARY AND CONCLUSIONS

and surface water sources

Riparian areas in the Carico Lake Allotment (CLA) are generally in poor condition due largely to the cumulative effects of concentrated livestock grazing. Observed impacts included: reduction of riparian vegetative communities, concentration of fecal waste, degradation of channel morphology and water quality Impacts to water quality were documented by the results of the baseline data monitoring and analyses conducted in 1999. Turbidity and fecal coliform were parameters which most significantly deviated from NDEP standards.

- 15 of 29 (52%) springs did not meet Class B standards for turbidity and/or fecal coliform bacteria.

**Example spring sites which were above or below water quality standards**

| Name | Dates | Turbidity (NTU) | Fecal Coliform Bacteria (/100 ml) |
|---|---|---|---|
| **Standards (Class B)** | | **50.0** | **400** |
| **Standards (Class C)** | | **100.0** | **1000** |
| Canyon Spring | 7/21/99 | 2.5 | 0 |
| Ferris Spring | 9/15/99 | 7.7 | 0 |
| New Moss Spring | 9/22/99 | 1.6 | 0 |
| Dry Gulch Spring | 8/25/99 | **486.0** | **320,000** |
| One Horn Spring | 8/31/99 | **242.0** | **25,000** |
| Old Trough Spring | 9/22/99 | **142.0** | **5,000** |

- 6 of 12 (50%) streams did not meet Class B standards for turbidity and/or fecal coliform bacteria.

**Example stream sites which were above or below water quality standards**

| Name | Dates | Turbidity (NTU) | Fecal Coliform Bacteria (/100 ml) |
|---|---|---|---|
| **Standards (Class B)** | | **50.0** | **400** |
| **Standards (Class C)** | | **100.0** | **1000** |
| Fish Creek (Upper) | 6/30/99 | 5.4 | 32 |
| Cook's Creek (Middle) | 7/7/99 | 0.9 | 10 |
| Ferris Creek | 9/15/99 | 1.6 | 0 |
| Cottonwood Creek | 7/14/99 | **180.1** | **1,500** |
| Moss Creek | 7/14/99 | **263.0** | **20,000** |
| Cook's Creek (Lower) | 8/17/99 | **101.0** | **8,000** |

Restoration of riparian areas, through implementation of recommended Best Management Practices (BMPs), would improve water quality, provide higher quality forage, rehabilitate channel integrity and function and restore or enhance streamflows.

**BMPs:**

1. Rest or closure of riparian areas- fencing and exclosures are used to reclaim heavily grazed areas. Water may need to be piped out of exclosures for livestock and wildlife.
2. Rotational grazing- preventing cattle from overusing riparian areas.
3. Herding- constant movement of cattle from riparian areas to upland areas.
4. Herd-size restrictions- achieved though reduction of AUM's.
5. Alternate methods to distribute livestock (i.e. salting practices and alternate water sources)
6. Restoration and protection of riparian areas.

Water quality data collected during this study provides a baseline which can be utilized to evaluate the effectiveness of implementation of the BMPs prescribed above during future allotment evaluations. Site specific analyses will be key to prescribing specific BMPs for individual springs or streams within the allotment.

This study provides managers with information on current water quality conditions in the Carico Lake Allotment and provides recommended BMPs. If implemented based upon site specific needs, these will improve water quality and overall health of affected watersheds. Furthermore, the actions will help to meet BLM resource management responsibilities under the Clean Water Act (§ 313) and be consistent with goals and directions as set forth in the Clean Water Action Plan.

## TABLE OF CONTENTS


ABSTRACT ..... i
SUMMARY AND CONCLUSION ..... i
TABLE OF CONTENTS ..... iv
LIST OF TABLES ..... v
LIST OF FIGURES ..... v
INTRODUCTION ..... 1
1. Physiography ..... 1
2. Land-Use ..... 1
3. Climate ..... 3
4. Vegetation ..... 3
5. Streams and Springs ..... 4
6. Beneficial Uses ..... 4
7. Objectives and Goals ..... 4
METHODS ..... 5
1. Sampling Periods ..... 5
2. Sampling Procedures ..... 5
3. Water Quality Standards ..... 8
4. Flow Measurements ..... 9
5. Condition of Usage ..... 10
RESULTS AND DISCUSSION ..... 10
1. Overall Characterization of Data ..... 10
2. Site Analysis ..... 13
3. Effects of Grazing and Trampling ..... 28
MANAGEMENT OBJECTIVES AND BEST MANAGEMENT PRACTICES ..... 29
1. Management Objectives ..... 29
2. Rangeland Health Standards ..... 29
3. Best Management Practices ..... 30
BIBLIOGRAPHY ..... 32
PROFESSIONAL CONSULTATION ..... 33

APPENDIX ..... 34
A: Water Quality Standards ..... 34
B: Sample location data (Tables 9, 10, 11, 12, and 13) ..... 38
C: Site Description of Springs and Creeks ..... 44

## LIST OF TABLES

PAGE


Table 1: List of EPA certified methods used by Acculabs ..... 8
Table 2: Cook's Creek Parameters ..... 14
Table 3: Fish Creek Parameters ..... 16
Table 4: Moss Creek and Spring Heads' Parameters ..... 17
Table 5: Elephant Head Exclosure Parameter ..... 19
Table 6: Nitrate and Phosphorous Concentrations at Elephant Head and Bridge's Well ..... 23
Table 7: Old Trough Spring Parameters ..... 24
Table 8: Horse Pasture Spring Parameters ..... 26
Table 9: Carico Lake Allotment- Sampling Period # 1 (Creeks) ..... 38
Table 10: Carico Lake Allotment- Sampling Period # 1 (Springs) ..... 39
Table 11: Metals Analysis of Select Locations ..... 40
Table 12: Carico Lake Allotment- Sampling Period # 2 (Creeks and Springs) ..... 41
Table 13: Carico Lake Allotment- Sampling Period # 3 (Creeks and Springs) ..... 42


## LIST OF FIGURES

PAGE


Figure 1: Physiographic Map of the Carico Lake Allotment ..... 2
Figure 2: Sampling Locations of the First Sampling Period ..... 6
Figure 3: Sampling Locations for the Second and Third Sampling Period ..... 7
Figure 4: Flow measurements in Upper Fish Creek ..... 9
Figure 5: Cook's Creek (7/7/99) ..... 13
Figure 6: Fish Creek Lower (6/30/99) ..... 15
Figure 7: Fish Creek Lower (9/22/99) ..... 15
Figure 8: Fecal Coliform Bacteria- Fish Creek ..... 16
Figure 9: New Moss Creek Spring (9/22/99) ..... 18
Figure 10: Moss Creek (7/14/99) ..... 18
Figure 11: Sampling Site Map at Elephant Head Exclosure) ..... 20
Figure 12: Outside Exclosure at Elephant Head (7/14/99) ..... 21
Figure 13: Exclosure at Elephant Head (7/14/99) ..... 21
Figure 14: Headwaters of Cottonwood Creek (7/14/99) ..... 22
Figure 15: Old Trough Spring (9/15/99) ..... 25
Figure 16: Fecal Coliform Bacteria- Old Trough Spring ..... 25
Figure 17: Horse Pasture Spring (6/10/99) ..... 27
Figure 18: Horse Pasture Spring (9/22/99) ..... 27

## INTRODUCTION

### 1. Physiography

The ranges, valleys and streams of the Carico Lake Allotment (CLA) are illustrated in Figure 1. The CLA includes Carico Lake Valley, part of the Reese River, Crescent and Grass Valleys. It also encompasses sections of the Shoshone and Toiyabe mountain ranges and a small corner of the Fish Creek mountains. Valleys and mountains are north-south trending with the entire CLA located within the Great Basin Section of the Basin and Range Physiographic Province. Elevations range from 8,543 feet at the top of Bald Mountain, to 4,651 feet in the northwest portion where the Reese River drainage is located. The majority of the CLA is contained within the Humboldt River watershed, within hydrographic areas 54, 55, 58 and 59 (Horton, 2000).

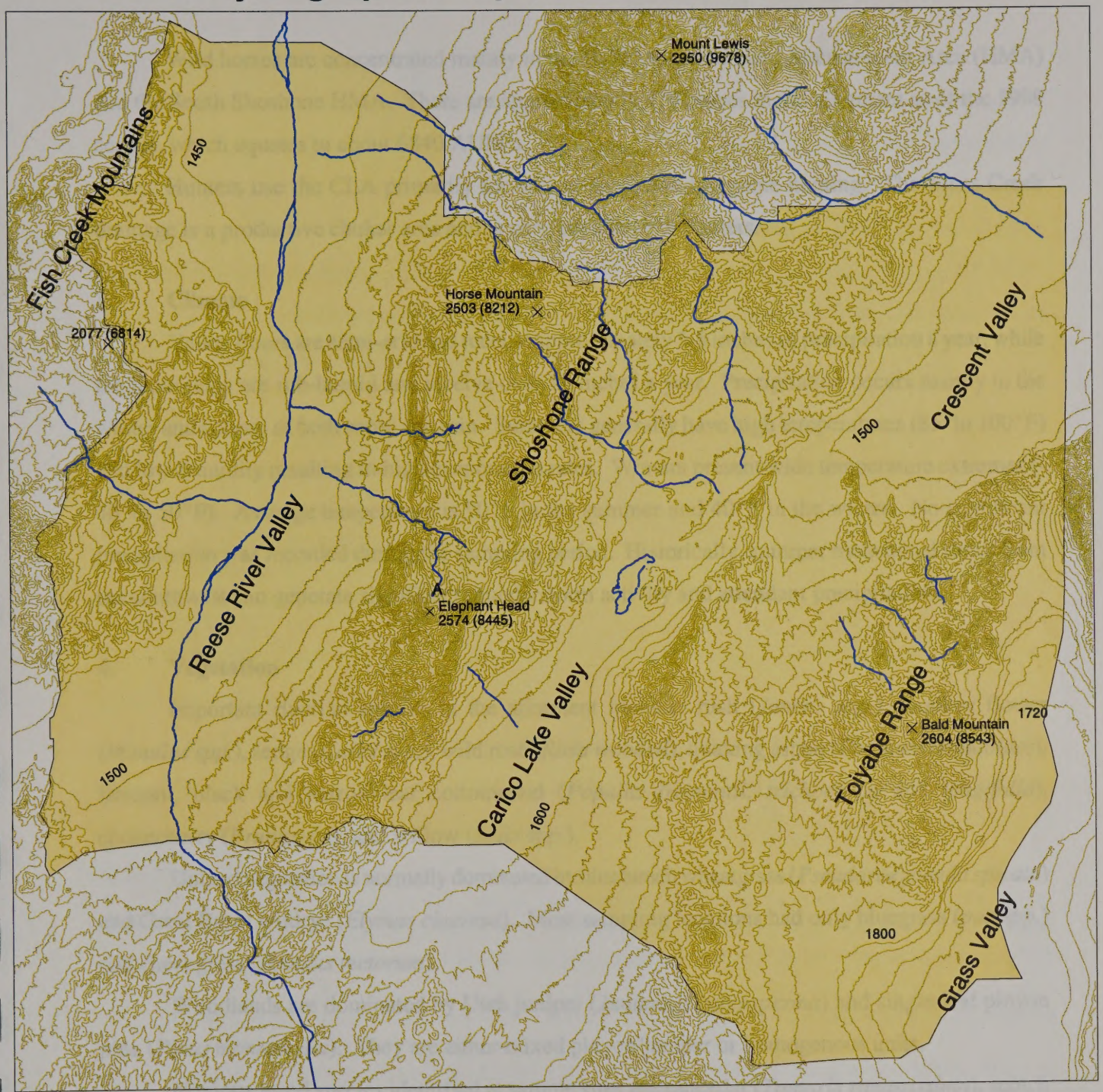
### 2. Land Use

Located in Lander County, the CLA is comprised of 563,190 acres of public land managed by the BLM and 35,516 private acres. Seven grazing permittees have a total authorized use for livestock of 34,127 animal unit months (AUM's). Users are allocated 29,101 AUM's for cattle and 5,026 AUM's for sheep. There are about 16.5 acres of public land for each AUM. Summer use occurs in the mountains and valleys, while winter use is primarily in the valleys.

There are four operational mines (McCoy, Greystone, Toiyabe, and Cortez) in the CLA.

Wildlife species known to inhabit the allotment include: pronghorn antelope (*Antelocapra americana*), sage grouse (*Centrocercus urophasianus*), chukar partridge (*Alectoris chukar*), mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*) and mountain lion (*Felis concolor*). Antelope seasonally reside in the southern part of Crescent Valley and the western side of Grass Valley. Mule deer spend their summers in higher elevations and winters in the mountain foothills and lowlands. Nevada BLM special status bird species include the sage grouse (*Centrocercus urophasianus*), golden eagle (*Aquila chrysaetos*), northern goshawk (*Accipiter gentalis*), ferruginous hawk (*Buteo regalis*), Swainson's hawk (*Buteo swainsoni*) and burrowing owl (*Speotyto cunicularia*).

# Physiographic Map of Carico Lake Allotment




8 0 8 16 Miles

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Streams

Contours (interval = 50 M)

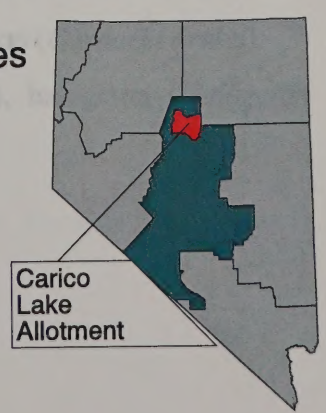



Figure 1: Physiographic Map of Carico Lake Allotment.

CMK '99

Wild horses are concentrated mainly in the Bald Mountain Herd Management Area (HMA) and the South Shoshone HMA. There are approximately 570 horses in the allotment as of the 1998 census, which equates to about 6840 AUM's.

Hunters use the CLA primarily for upland game and big game hunting. The Moss Creek drainage is a productive chukar area and is very popular with hunters.

## 3. Climate

Valley floors are semi-arid and receive approximately 5-8 inches of precipitation a year, while the mountains are sub-humid and receive over 15 inches a year. Precipitation occurs mainly in the winter and spring, as both snow and rain. Summers generally have high temperatures (85°to 100°F) and low humidity resulting in high evaporation rates. Winters present wide temperature extremes (-40°to 50°F). Average temperature is 90°F in the summer and 40°F in the winter. No significant precipitation was recorded during the sampling period. Historically, summer monsoonal flows from the southwest can generate significant thunderstorm activity and attendant precipitation.

## 4. Vegetation

Important riparian species in the allotment include: rush (*Juncus spp.*), monkey flower (*Mimulus spp.*), sedge (*Carex spp.*), wild rose (*Rosa woodsii*), quaking aspen (*Populus tremuloides*), fremont, black and narrow-leaf cottonwood (*Populus fremontii, trichocarpa* and *longifolia*), chokecherry (*Prunus sp.*), and willow (*Salix spp.*).

Upland vegetation is normally dominated by bluebunch wheatgrass (*Pseudoroegnemia spicata*) and Great Basin wildrye (*Elymus cinereus*). Most sampling locations had only bluegrass (*poa spp.*) and cheat grass (*Bromus tectorum*).

Woodlands are dominated by Utah juniper (*Juniperus osteosperma*) and single-leaf pinyon pine (*Pinus monophylla*). They are either mixed pinyon/juniper or homogenous units.

Noxious weed species identified at sample sites are saltcedar (*Tamarix ramosissima*), scotch thistle (*Onopordum acanthium*), musk thistle (*Carduus nutans*) and whitetop (*Cardaria draba*).

Undesirable species present are cheat grass (*Bromus tectorum*), halogeton (*Halogeton glomeratus)* and pepperweed (*Lipidium spp.*).

## 5. Streams and Springs

Peak flows on allotment streams occur in spring and early summer in response to spring rainfall and snow melt from higher elevations. During low flow periods, perennial streams are sustained by groundwater-fed springs. Perennial streams are Fish, Moss, Cottonwood, Ferris, Indian, Mill, and Harry Canyon Creeks. Intermittent streams are Cook's, Elder and Wilson Canyon Creeks. Historically, the Reese River has been ephemeral in the CLA and had stopped flowing by 6/29/99.

Springs are mostly groundwater seeps arising due to aquifer pressure from higher elevations and occur in close proximity to the base of mountain ranges.

## 6. Beneficial Uses

Many beneficial uses can exist in the CLA.

1. Livestock, wild horses and wildlife watering
2. Aquatic life propagation
3. Recreation
4. Groundwater recharge
5. Irrigation
6. Grazing

## 7. Objectives and Goals

The objectives of this project were to determine the quality of surface waters (i.e. streams and springs) and the effects current land uses have on these sources. Management goals are to improve or restore water quality and overall watershed health.

**Objectives**

1. Test physical parameters (i.e. water temperature, dissolved oxygen, specific conductance, salinity, pH) electronically in the field and chemical parameters (i.e. nitrate nitrogen, nitrite nitrogen, ammonia nitrogen, total phosphorous, turbidity, fecal coliform bacteria) at a certified laboratory.
2. Analyze riparian conditions including current health, vigor, and regeneration of vegetative communities through visual inspection.
3. Analyze stream morphology including obstructions in natural flow (i.e. trampling, trails or roads), erosion, channel deposition and bank stability.
4. Compare physical and chemical data to NDEP water quality standards.
5. Document the physical state of sample locations using digital camera imagery.

**Goals**

1. Design and recommend best management practices (BMPs) which will improve overall health and water quality of streams and springs.
2. Identify these BMPs in allotment evaluation plans and implement in future permit renewals and other relevant land use authorizations.

## METHODS

### 1. Sampling Periods

The first sampling period (6/29/99 to 7/21/99) was designed to sample representative surface water sources over the entire allotment (Figure 2). Streams and springs were bracket-sampled in order to determine the source of pollution. In streams, one sample was obtained from the upper headwaters, while another grab was obtained at the lowest point in the watershed where flow was still adequate. Some springs had two samples taken: one at the spring head and one below the main body of the spring. If springs had only one sample analyzed, it was acquired at considerable distance downstream from the head to effectively represent any water quality degradation. Samples were also taken up-gradient from roads to minimize possible influences.

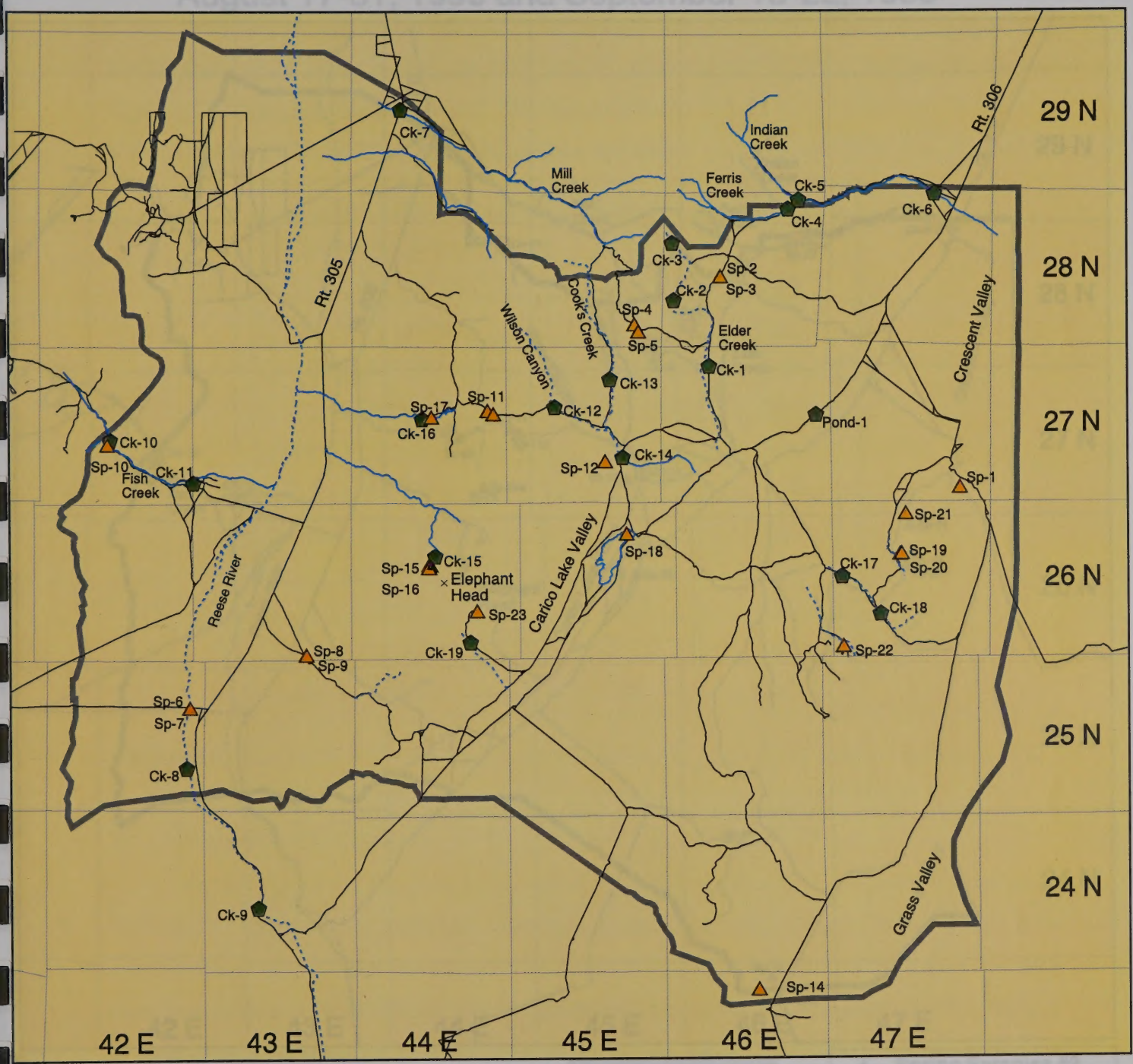
The second sampling period (8/17/99 to 8/31/99) focused on locations that previously recorded extremely high fecal coliform counts (i.e. greater than 1000 m.p.n.) or levels that were "Too Numerous To Count"(TNTC) (Figure 3). Samples were taken at identical locations as the first period. Additional locations that exhibited intensive use were also sampled.

The third sampling period (9/15/99 to 9/22/99) followed similar procedures as the second sampling period, providing data during low flow (Figure 3).

### 2. Sampling Procedures

Dissolved oxygen, specific conductance, salinity and temperature were measured using a Hach YSI-85 meter. A Hanna Instruments 8314 membrane meter was used to measure pH. Both instruments are EPA certified. In addition, representative grab samples were collected in sterilized bottles, preserved on ice and sent to Acculabs (EPA certified lab) within 24 hours. Where springs were too shallow to submerse bottles, sterilized 60cc syringes were used to transfer water.

# Carico Lake Allotment: First Sampling Period
# June 29, 1999 to July 21, 1999

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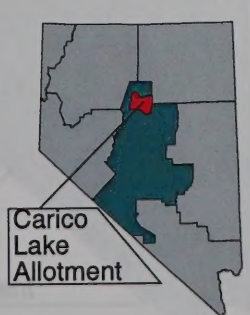
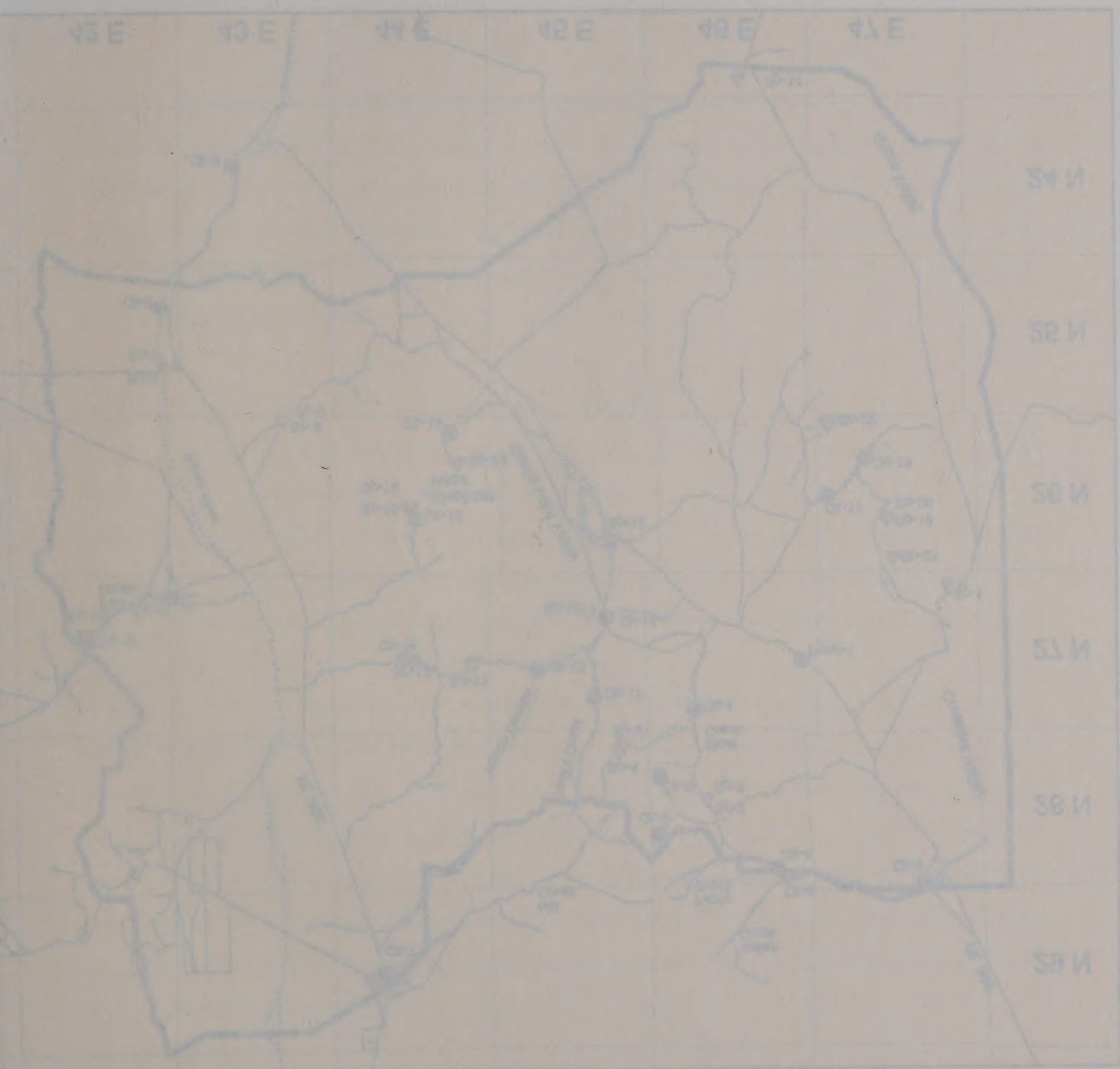



Springs
Creeks
**Streams**
Perennial
Intermittent
Roads
Allotment Boundary
Range and Township Boundaries

CMK

Figure 2: Map of Sampling Locations for the First Sampling Period.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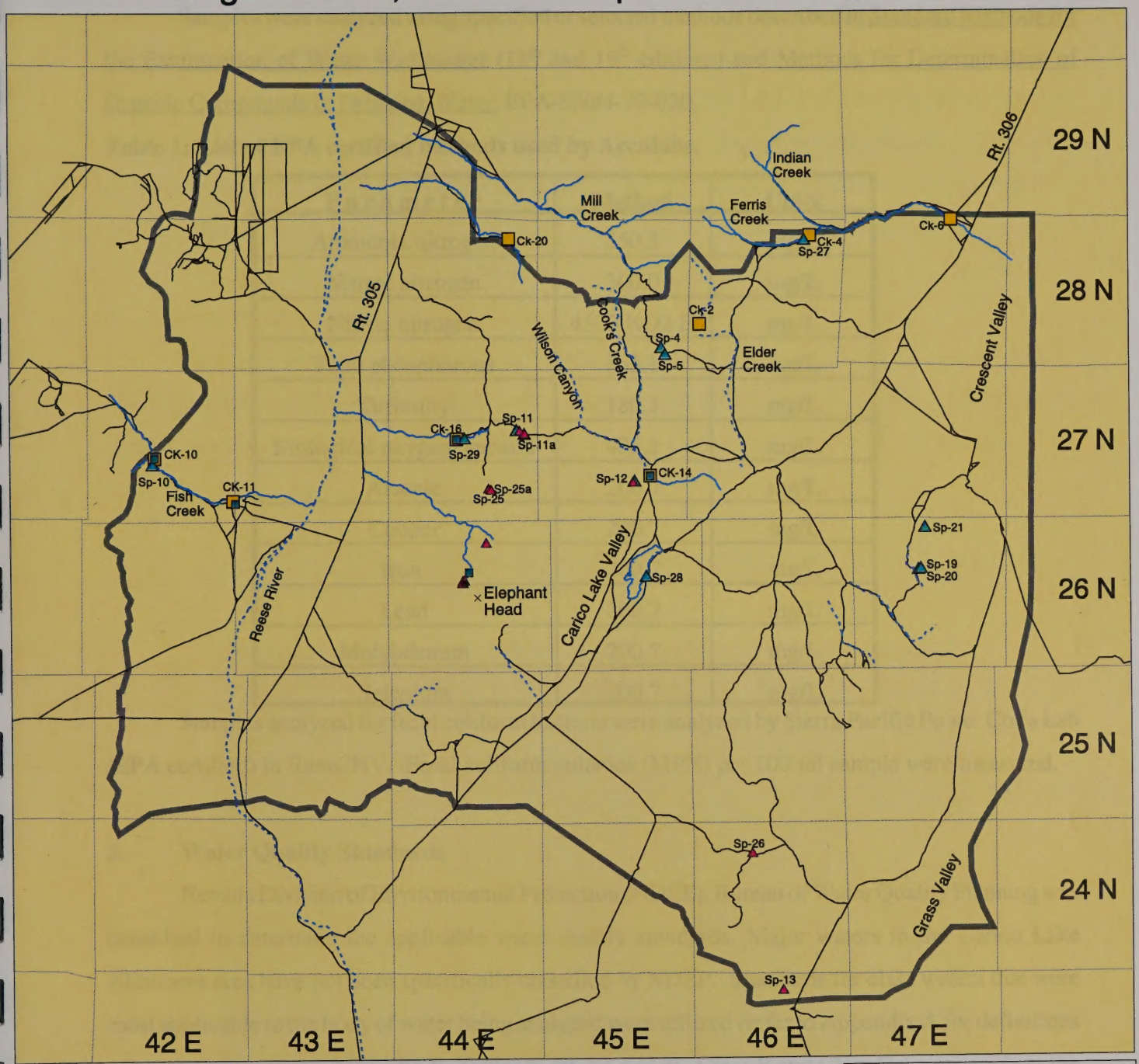
# Carico Lake Allotment: Second and Third Sampling Period
# August 17-31, 1999 and September 15-22, 1999

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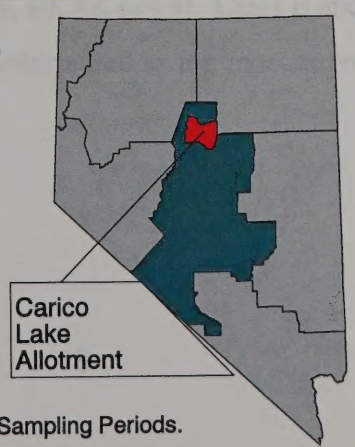


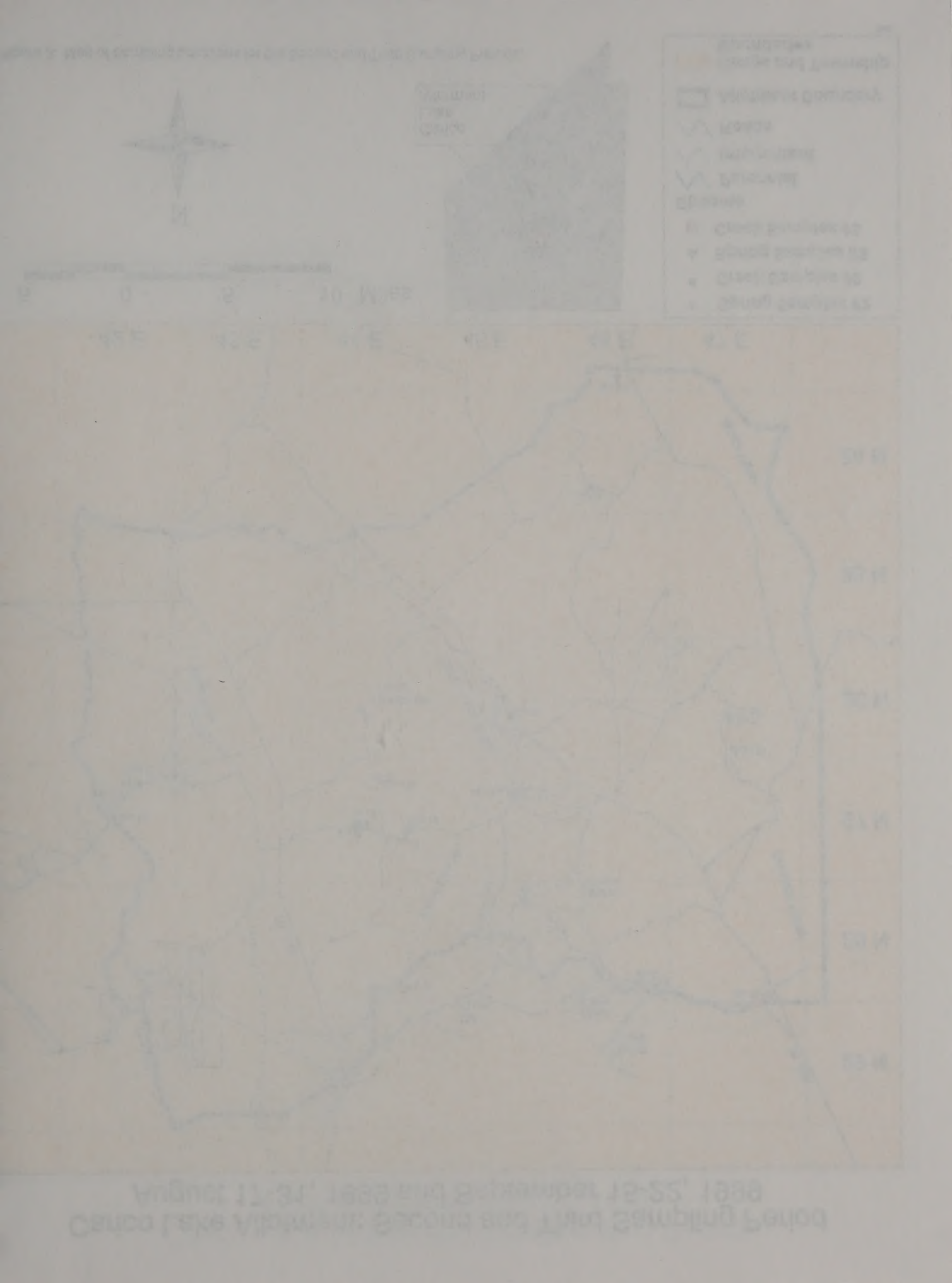

- Spring Samples #2
- Creek Samples #2
- Spring Samples #3
- Creek Samples #3

**Streams**

- Perennial
- Intermittent
- Roads
- Allotment Boundary
- Range and Township Boundaries

CMK

Figure 3: Map of Sampling Locations for the Second and Third Sampling Periods.



Samples were analyzed using specified or selected methods described in Standard Methods for the Examination of Water Wastewater (18th and 19th editions) and Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020.

**Table 1: List of EPA certified methods used by Acculabs.**

| Parameter | Method | Units |
|---|---|---|
| Ammonia nitrogen | 350.3 | mg/L |
| Nitrate nitrogen | 300.0 | mg/L |
| Nitrite nitrogen | 4500 NO2 B | mg/L |
| Total phosphorous | 365.1 | mg/L |
| Turbidity | 180.1 | mg/L |
| Biological oxygen demand | 405.1 | mg/L |
| Arsenic | 200.7 | mg/L |
| Copper | 200.7 | mg/L |
| Iron | 200.7 | mg/L |
| Lead | 200.7 | mg/L |
| Molybdenum | 200.7 | mg/L |
| Selenium | 200.7 | mg/L |

Samples analyzed for fecal coliform bacteria were analyzed by Sierra Pacific Power Co.'s Lab (EPA certified) in Reno, NV. Fecal coliform colonies (MPN) per 100 ml sample were measured.

## 3. Water Quality Standards

Nevada Division of Environmental Protection (NDEP), Bureau of Water Quality Planning was consulted to determine the applicable water quality standards. Major waters in the Carico Lake Allotment area have not been specifically classified by NDEP. Standards for class waters that were most applicable to the body of water being analyzed were utilized (refer to Appendix A for definitions of water classes or see Appendix B, Tables 9, 10, 12, or 13). Class B and Class C waters apply to the watersheds in the allotment. Class B was interpreted as the most appropriate classification for the majority of sample locations.

Specific conductance was approximated from standards for total dissolved solids (TDS). TDS is approximately two thirds of specific conductance. Turbidity standards ( Appendix A) are classified by cold water (10 NTU) and warm water (50 NTU) for aquatic life. These standards apply to fisheries and due to the lack of adequate aquatic habitats in the CLA these were inapplicable. Therefore, following consultations with NDEP, 50 and 100 NTU were used for moderate and high turbidity levels, respectively.

## 4. Flow Measurements

Flow measurements (feet/second- fs) were taken where sufficient water was present(Figure 4). Readings were taken at 0.6 of the depth with a pygmy current meter at one foot intervals across the channel cross-section. Discharge was calculated in cubic feet/second (cfs) using equation 1:

$$Q = \overline{V} \times W \times \overline{D} \qquad (1)$$

Where Q = discharge; $\overline{V}$= the average velocity; W= the total width of the stream segment; and D= the average depth.

**Figure 4: Taking flow measurements in upper Fish Creek (3/13/00).** Saltcedar are present along streambanks.

## 5. Condition of Use

The existing condition of riparian vegetation and stream channel integrity was ranked subjectively using the following criteria:

"Low" designates areas with riparian vegetation with high production and density, low grazing presence and healthy stream channels with little to no trampling or alteration.

"Moderate" denotes locations with grazing evidence and plant utilization, and evidence of trampling.

"Heavy" indicates areas that exhibit little remaining vegetation, alterations in spring flow, bank erosion in streams and considerable trampling.

"Extreme" represents areas that are nearly grazed barren of vegetation and/or have major alterations in the stream channel due to excessive trampling.

# RESULTS AND DISCUSSION [1, 2]

The first section discusses a generalization of the information found from each of the parameters analyzed over the three sampling periods. The second section presents an analysis of some of the most important water sources in the allotment. The third section discusses some findings of the effects of grazing.

## 1. Overall Characterization of Data

The analysis of field parameters (i.e. specific conductance, water temperature and dissolved oxygen) presented the broad water quality characteristics of this allotment. Specific conductance measures the ability of substances in water to conduct an electric current with temperature compensation (at 25°C). It ranged from as low as 104.6 micro Siemens per centimeter ($\mu$S/cm) at the exclosure near Elephant Head (a non-grazing area) to 1690.0 $\mu$S/cm at Hole in the Wall spring in a depression pond (a heavily grazed area). The average conductance of springs and streams during the three sampling periods was 588 $\mu$S/cm. Natural specific conductance varies due to the mobility of charged ionic species present in the environment through which water flows. Increases in specific conductance were observed in areas with heavy grazing and stagnant water (i.e. Hole in the Wall, Horse Pasture, One Horn and Elephant Head springs).

---

1 Data (including UTM's) on all spring and stream sampling locations can be found in Appendix B, Tables 9, 10, 11, 12, and 13.
2 Detailed field descriptions of all locations sampled can be found in Appendix C.

Water temperature displayed significant down-gradient increases in streams (i.e. Fish Creek, Cook's Creek and Indian Creek); primarily due to lack of vegetative shading and increases in width-depth ratios resulting from intensive grazing. Water temperature was above Class B standard in 5 of 12 (42%) streams.

Springs had low water temperatures directly at spring heads due to lower temperatures of emerging ground water. In areas with a great deal of trampling and flow dispersion, temperatures significantly increased due to lack of shading and entrapment of water (i.e. Hole in the Wall, Horse Pasture, One Horn and Elephant Head springs). Downstream from spring heads, 11 out of 29 (38%) sites had water temperature above the Class B standard.

Dissolved oxygen (D.O.) was present in adequate concentrations (>5.0 mg/L) for all of the streams. Streams remained at adequate levels for D.O. due to flowing water which generates oxygen from riffling, absorption from the atmosphere or by photosynthesis (D.O. is produced by aquatic plants as a by-product of photosynthesis, Fogg et al. 1998). Oxygen saturation levels in water decreased with increased water temperature.

Spring heads had lower D.O.: resulting from lower D.O. content of groundwater and minimal flow. In highly disturbed springs, D.O.'s remained constant or decreased because trampling depressions prohibited flow (Hole in the Wall, Elephant Head and Pasture springs). Additionally, aerobic bacteria feeding on fecal matter in these depressions consume oxygen.

Laboratory analysis of the chemical parameters of nitrate, nitrite, ammonia nitrogen and total phosphorous did not provide information which can be correlated by large ungulate usage. Most concentrations for nitrate, nitrite, and ammonia nitrogen were below detectable limits or very minimal for both springs and streams. Phosphorous concentrations were above Class B standard for 66% of streams and 48% of springs. Typically, nutrient concentrations are opposite of this because nitrogen concentrations generally move faster into the watershed than phosphorous, which attaches to soil particles (U.S. Geological Circular 1999). In order for eutrophication or algal blooms to occur, the algae requires both nitrogen and phosphorous. The lack of large amounts of algal blooms in the majority of locations may indicate that the water is nitrogen limited. Non-natural supplies of nitrogen and phosphorus come from fertilizers (U.S. Geological Circular, 1999) which may be used near Bridge's Well for the alfalfa fields.

Turbidity data from the laboratory analysis proved to be very informative. Turbidity is the amount of sediment suspended in water, which can be caused by erosion (Ohlenbusch, et al. 1998). The suspension of sediments can deliver potential pollutants, such as nutrients or indicator bacteria, to downstream locations (Ohlenbusch, et al. 1998). Values for turbidity were very high and are directly related to the presence of cattle, wildlife and wild horses in the CLA. Heavy grazing and trampling increase turbidity levels by eliminating vegetation, decreasing soil stability(i.e. promoting erosion) and causing direct bed disturbance. Turbidity levels increased from less than 10 NTU at spring heads to greater than 100 NTU downstream (Moss and Cottonwood Creeks). Turbidity was above 50 NTU for 33% of streams and 31% of springs. Fecal coliform bacteria originate directly from the intestinal tract of vertebrates and reflect the amount of waste being excreted into water sources (Kubek et al. 1990). They also suggest the potential for the presence of other disease pathogens. High fecal coliform bacteria levels indicate that cattle are frequently excreting directly into water sources (Moore et al. 1993).

Fecal coliform bacteria levels did not meet Class B standards for 50% of streams and 52% of springs. Increases were observed as water flowed through heavily grazed riparian areas (i.e. Old Trough Spring and Horse Pasture Spring) or downstream in creeks (i.e. Fish and Moss Creeks). The high levels are caused by cattle and other animals excreting directly into the water. Some fecal levels were reported as "Too Numerous To Count (TNTC)". "TNTC" was interpreted as at least 1000 colonies of bacteria per 100 mL. Samples which came back as "TNTC" were re-tested at a future date for comparison.

The biological oxygen demand (BOD) was analyzed on a few sights to determine if there were other factors affecting the nitrate nitrogen concentrations in the creeks. BOD analyzes the amount of oxygen that is used by microbiological activity over a five day incubation period. This test determined that the microbiological activity occurring in streams and springs in Carico was minimal and was not playing a role in the consumption of nitrate nitrogen.

Specific metals (i.e. arsenic, copper, iron, lead, molybdenum and selenium) were analyzed to discover any influences from mining activities (Table 3). This procedure was recommended by Tom Nash, geologist, U.S.G.S.. Iron and molybdenum exceeded standards in the Reese River (Ck-9). In addition, some arsenic was detected. Molybdenum was detected at Copper Canyon and Greystone mine, but was below state standards.

## 2. Site Analysis

The sites discussed below are water sources which are important to this allotment. They are significant because of the continuous grazing and degradation of water quality which occur in these areas. About 50% of the sampling locations in this allotment did not meet Class B standards for at least two of the following parameters: water temperature, dissolved oxygen, phosphorous, turbidity, fecal coliform bacteria

*Cook's Creek*

Erosion occurring along this stream is transporting significant sediment loads downstream (Table 2). The upper section of the stream had a streambed consisting of sandy-to-rocky bottom, while the lower location was covered with silt deposits (Figure 5). Silt is depositing at the lower section because of increased width-depth ratios which decrease energy and allow sediment to settle. Livestock trails and trampling are causing some of the erosion problems along this stream.

**Figure 5: Lower section of Cook's Creek (7/7/99).** Large width to depth ratio, bank erosion and lack of riparian species.

**Table 2: Cook's Creek Parameters.**

| *Sampling Dates* | *Location* | *Water Temp. (°C)* | *Dissolved $O_2$ (mg/L)* | *Specific Cond. (µS/cm)* | *Turbidity (NTU)* | *Fecal Coliform Bacteria* |
|---|---|---|---|---|---|---|
| **Standards** | **Class B** | **24.0** | **>5.0** | **800.0** | **50.0** | **400** |
| 7/7/99 | Upper C. C. | 19.2 | 11.9 | 297.4 | 0.9 | 10 |
| 7/7/99 | Lower C. C. | **28.0** | 10.6 | 694.0 | 9.9 | 1000* |
| | Increases | 8.8 | -1.3 | 396.6 | 9.0 | 990* |
| 8/17/99 | Lower C. C. | **28.1** | 14.1 | 726.0 | **101.0** | **8,000** |
| 9/22/99 | Lower C. C. | 14.6 | 11.1 | 697.0 | **62.6** | **2,000** |

*= Returned from laboratory as "Too Numerous To Count"
(The upper sampling location was not sampled after 7/7/99 since it had interrupted flow)

Water temperature, turbidity and fecal coliform bacteria do not meet standards for Class B waters. Fecal coliform bacteria and turbidity also exceed Class C standards. The high concentrations of fecal coliform measured in this stream are directly related to concentrated livestock use. The decrease in dissolved oxygen on 7/7/99 is a function of the significant increase in water temperature (i.e. the ability of water to hold oxygen decreases with increases in temperature). The increase in temperature may also be related to the increase in width-depth ratio and the lack of vegetation along the stream channel. These factors can also decrease dissolved oxygen.

*Fish Creek*

This stream had the largest discharge (about 3 to 5 cfs) throughout the sampling periods (June 29 to September 22, 1999) of any of the streams. The condition of this creek rapidly deteriorates from upstream to downstream (Table 3). The lower end is intensively grazed, resulting in a significant decrease of riparian vegetation (Figure 6 and 7). This loss of cover will continue to accelerate erosion due to the inherent lack of soil stability. Lack of soil stability is a major concern in this watershed as the channels are incised as much as thirty feet in sections. Infestations of thistle and saltcedar along the streambanks are indicators of degraded riparian and overall watershed health.

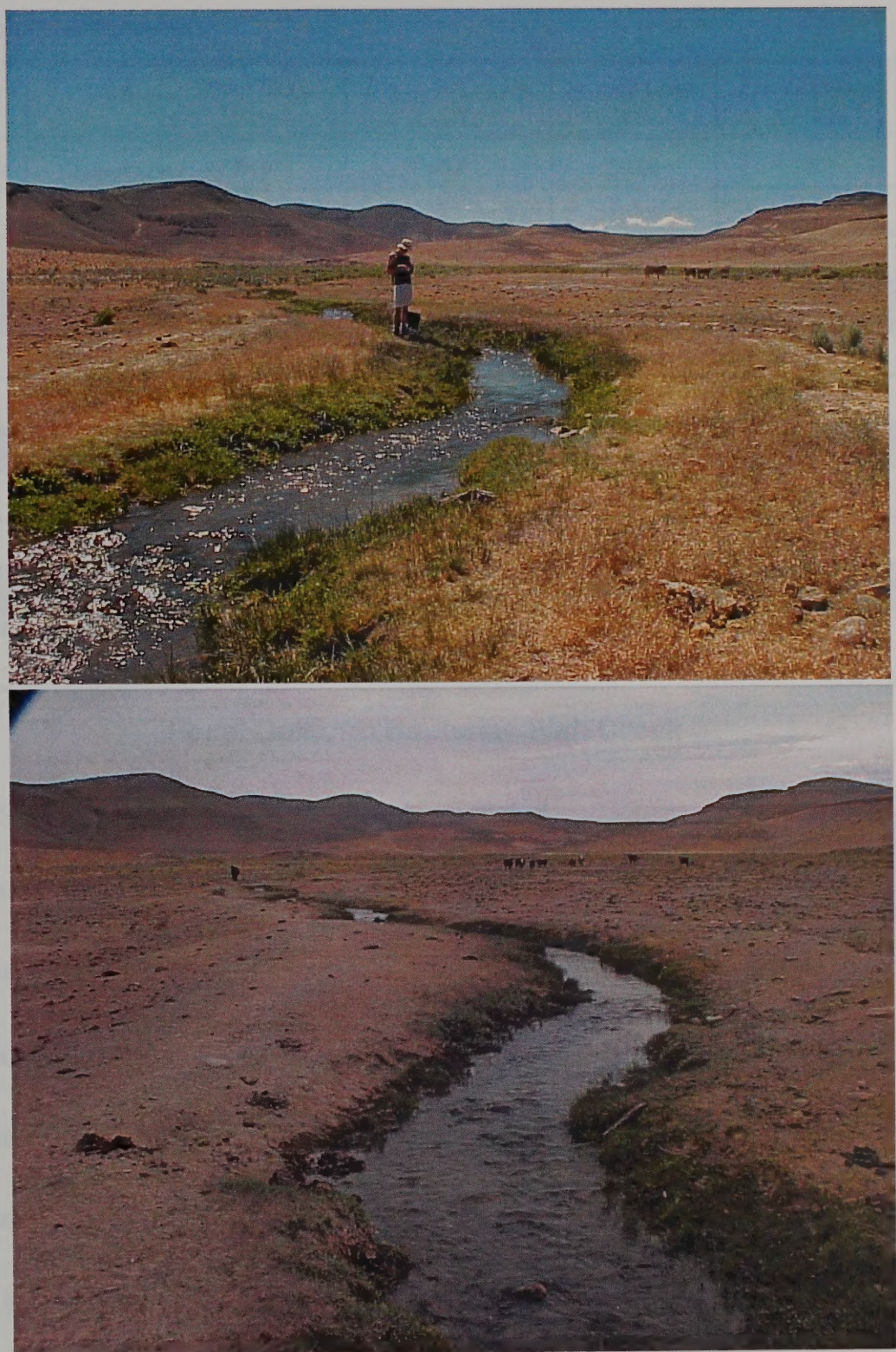


**Figure 6 and 7: Lower Fish Creek on 6/30/99 (top) and 9/22/99 (bottom).** In the beginning of the summer, grazing has caused a lack of diversity and production in vegetation. After 3 months of intensive livestock grazing, very little vegetation remains and the stream channel is left vulnerable to erosion.

**Table 3: Fish Creek Parameters.**

| *Sampling Dates* | *Location* | *Water Temp. (°C)* | *Dissolved Oxygen (mg/L)* | *Specific Cond. (µS/cm)* | *Fecal Coliform Bacteria* |
|---|---|---|---|---|---|
| **Standards** | **Class B** | **24.0** | **>5.0** | **800.0** | **400** |
| 6/30/99 | Upper F.C. | **25.3** | 8.3 | 423.6 | 32 |
| 6/30/99 | Lower F.C. | **27.2** | 8.1 | 476.3 | **1000*** |
| | Increase | 1.9 | -0.2 | 52.7 | 968* |
| 8/17/99 | Upper F.C. | 11.9 | 13.6 | 538.0 | 78 |
| 8/17/99 | Lower F.C. | 13.1 | 11.8 | 566.0 | 376 |
| | Increase | 1.2 | -1.8 | 28.0 | 298 |
| 9/22/99 | Upper F.C. | 15.8 | 8.8 | 548.0 | 92 |
| 9/22/99 | Lower F.C. | 16.5 | 8.2 | 565.0 | **400** |
| | Increase | 0.7 | -0.6 | 17.0 | 308 |

*= Returned from laboratory as "Too Numerous To Count"

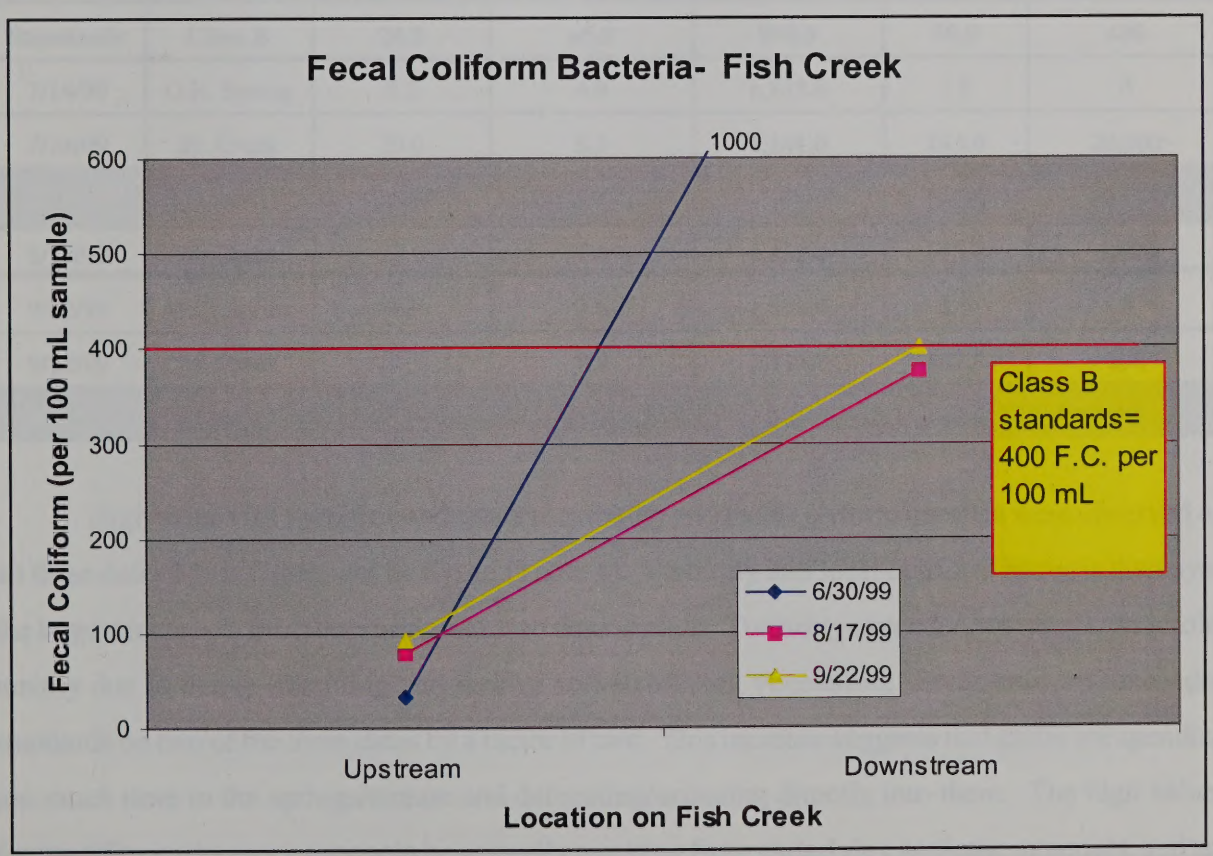



**Figure 8: Specific Conductance and Fecal Coliform Bacteria- Fish Creek.**

Downstream increases were observed for most parameters on all of the sampling dates (Table 3, Figure 8). The significant increase in fecal coliform bacteria levels from upstream to downstream is directly related to livestock grazing. Temperature increases and dissolved oxygen decreases may be caused by the lack of vegetation in the lower section of Fish Creek.

*Moss Creek*

Moss Creek is fed by a number of springs, although the creek was mainly sustained by Orange Rock Spring (O.R.) on the first two sampling periods and New Moss Creek Spring (M.C.) on the third sampling period. Heavy cattle grazing was occurring directly at the spring heads, where at least 20 head of cattle were observed on all three sampling dates (Figure 9). Moss Creek was sampled about 300 yards downstream from these spring heads at a stream section which is heavily grazed and exhibits bank erosion (Figure 10).

**Table 4: Moss Creek and Spring Heads' Parameters.**

| *Sampling Dates* | *Location* | *Water Temp. (°C)* | *Dissolved Oxygen (mg/L)* | *Specific Cond. (µS/cm)* | *Turbidity (NTU)* | *Fecal Coliform Bacteria* |
|---|---|---|---|---|---|---|
| **Standards** | **Class B** | **24.0** | **>5.0** | **800.0** | **50.0** | **400** |
| 7/14/99 | O.R. Spring | 9.2 | 4.9 | **1,133.0** | 1.2 | 0 |
| 7/14/99 | M. Creek | 20.0 | 8.3 | **1,141.0** | **263.0** | **20,000** |
| | Increase | 10.8 | 3.4 | 8.0 | 261.8 | 20,000 |
| 8/17/99 | M. Creek | 22.6 | 7.6 | **1,152.0** | **513.0** | **1,000** |
| 9/22/99 | M.C. Spring | 9.3 | 2.6 | **1,095.0** | 1.6 | 0 |
| 9/22/99 | M. Creek | 14.3 | 7.9 | **1,116.0** | **157.0** | 200 |
| | Increase | 5.0 | 5.3 | 21.0 | 155.4 | 200 |

High values for specific conductance, turbidity and fecal coliform bacteria were observed on all three dates Moss Creek was analyzed (Table 4). Turbidity and fecal coliform bacteria displayed the largest increases from the spring heads to downstream. Turbidity exceeded standards, threefold, mainly due to heavy trampling and lack of soil-stabilizing vegetation. Fecal coliform exceeded standards on two of the three dates by a factor of two. This increase suggests that cattle are spending too much time in the springs/stream and defecating/urinating directly into them. The high values for specific conductance appear to be naturally resulting from underlying geologic materials, and are not associated with grazing.

**Figure 9 (top): New Moss Creek Spring (9/22/99).** Main flow for Moss Creek comes from this spring. Burdensome trampling from cattle is causing high turbidity and obstruction of flow.
**Figure 10 (bottom): Moss Creek (7/14/99).** Bank erosion caused by lack of vegetation and trampling is leading to high turbidity in creek.

*Elephant Head Basin*

This basin occupies over 5,000 acres of sub-alpine to alpine terrain ranging in elevation from 7,000 feet (2133 meters) to over 8,000 feet (2440 meters). The area has a few scattered stands of quaking aspen which represent some of the remnant stands surviving within this allotment. In this basin, the headwaters to Cottonwood Creek are heavily grazed by livestock. An exclosure exists which protects a perennial spring from livestock grazing (Table 5, Figure 11). Visible differences in the condition of this area can be seen clearly (Figure 12, 13, and 14- labeled as A, B, and C, respectively, on Figure 11).

**Table 5: Elephant Head Exclosure Parameters (Reference Figure 11).**

| *Date* | *Site ID* | *Water Temp. (°C)* | *Dissolved $O_2$ (mg/L)* | *Specific Cond. (µS/cm)* | *Turbidity (NTU)* | *Fecal Coliform Bacteria* |
|---|---|---|---|---|---|---|
| **Standards** | **Class B** | **24.0** | **>5.0** | **800.0** | **50.0** | **400** |
| 7/14/99 | Sp-15a | 9.5 | 8.2 | 169.9 | ** | ** |
| 7/14/99 | Sp-15 | 12.3 | 9.1 | 120.4 | 12.9 | **400** |
| Increase | | 2.8 | 0.9 | -49.5 | (12.9) | (400) |
| 7/14/99 | Sp-16a | 8.0 | 10.9 | 206.2 | ** | ** |
| 7/14/99 | Sp-16 | 13.8 | 10.0 | 226.6 | 35.2 | **3000** |
| Increase | | 5.8 | -0.9 | 20.4 | (35.2) | **(3000)** |
| 7/14/99 | Ck-15 | 14.3 | 11.1 | 288.2 | **180.1** | **1500** |
| 8/31/99 | Sp-15a | 12.0 | 3.7 | 104.6 | ** | ** |
| 8/31/99 | Sp-15 | 9.7 | 11.0 | 197.1 | 0.5 | **660** |
| Increase | | -2.3 | 7.3 | 92.5 | (0.5) | (660) |
| 8/31/99 | Sp-16a | 8.5 | 8.4 | 217.7 | ** | ** |
| 8/31/99 | Sp-16 | 13.5 | 7.3 | 218.2 | 21.0 | **600** |
| Increase | | 5.0 | -1.1 | 0.5 | (21.0) | (600) |
| 8/31/99 | Ck-15 | 11.8 | 11.5 | 242.5 | **59.0** | **600** |

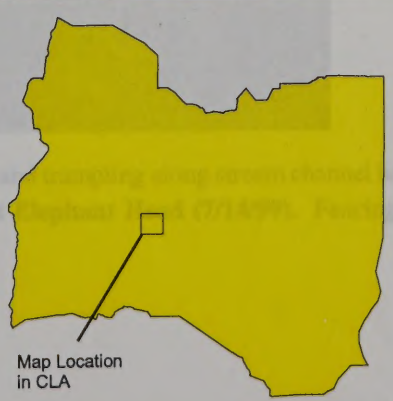
**= Not analyzed
( )= Predicted increase

# Sampling Site Map at Elephant Head Exclosure

Creek Samples
Spring Samples
Streams
Contours (Interval = 50 M)

1:5000

N




CMK '99

Figure 11: Sampling Site Map at Elephant Head Exclosure

Figure 11: Sampling Site Map at Elephant Head Exclosure

**Figure 12 (A, top): Outside Exclosure at Elephant Head (7/14/99).** Grazing and trampling along stream channel have caused erosion and disruption of flow. **Figure 13 (B, bottom): Exclosure at Elephant Head (7/14/99).** Fencing to exclude cattle has allowed for regrowth of vegetation.

**Figure 14 (C) : Headwaters to Cottonwood Creek (7/14/99).** Intensive grazing and trampling are affecting turbidity and fecal coliform levels in Cottonwood. Hoof prints are obstructing flow and causing ponding.

Comparison of Sp-15 (exclosure) and Sp-16 (outside exclosure) reveals that specific conductance, water temperatures and turbidity were lower inside the exclosure. Water temperature had a larger increase outside the exclosure on both dates due to the lack of vegetation and subsequent shading. Dissolved oxygen decreased outside the exclosure and increased inside. This is due to the natural rocky stream channel and heavier vegetation within the exclosure. Levels of fecal coliform bacteria were about 7 times greater outside the exclosure on 7/14/99. However, on 8/31/99, bacteria levels were slightly lower outside the exclosure. Grazing activity which was present at the spring head, may be contributing to the fecal coliform bacteria levels within the exclosure. Also, fecal coliform bacteria may remain alive in the sediment for several weeks (Sherer et al. 1992). Therefore, cattle influences may have continued since the fence was repaired on 6/6/99.

**Table 6: Nitrate and phosphorous concentrations at Elephant Head and Bridge's Well.**

| | *Date* | ***Standards Class B*** | *Sp-15* | *Sp-16* | *Ck-15* | *Bridge's Well (6/30/99)* |
|---|---|---|---|---|---|---|
| Nitrate (mg/L) | 7/14/99 | **10.0** | 6.3 | 3.7 | 2.9 | 1.8 |
| Phosphorous (mg/L) | 7/14/99 | **0.3** | 0.12 | 0.19 | 0.15 | 0.17 |
| Nitrate (mg/L) | 8/31/99 | **10.0** | 6.9 | 2.8 | 3.9 | ** |
| Phosphorous (mg/L) | 8/31/99 | **0.3** | <0.05 | **0.36** | 0.11 | ** |

**= Not analyzed

Nitrate nitrogen concentrations were above detection limits at only four sites (Table 6). Two springs (Sp-15 and Sp-16) and Cottonwood Creek (Ck-15) had significant nitrate nitrogen concentrations on both sampling dates. Nitrate nitrogen concentration was also evident at Bridge's Well (Sp-6). In relation to other springs and streams in CLA, these sites may receive natural sources of nitrates from groundwater. Heavy algal blooms were seen at the western pond of Bridge's Well, but not at the headwaters of Cottonwood Creek.

*Old Trough Spring*

Old Trough spring is in degraded physical condition from heavy grazing and trampling by cattle (Figure 15). Ground water seeping from the spring head has good water quality, but quickly deteriorates as it flows through eroded soil and feces (Table 7, Figure 16). There is no defined flow-channel for 40 yards below the spring head due to trampling.

**Table 7: Old Trough Spring Parameters.**

| *Sampling Dates* | *Old Trough Location* | *Water Temp. (°C)* | *Dissolved $O_2$ (mg/L)* | *Specific Cond. (µS/cm)* | *Turbidity (NTU)* | *Fecal Coliform Bacteria* |
|---|---|---|---|---|---|---|
| **Standards** | **Class B** | **24.0** | **>5.0** | **800.0** | **50.0** | **400** |
| 7/7/99 | Spring head | 14.6 | 5.1 | 322.6 | ** | ** |
| 7/7/99 | ½ mile down gradient | 17.7 | 8.2 | 216.7 | **148.0** | **1000*** |
| Increases | | 3.1 | 3.1 | -105.9 | (148) | (1000) |
| 8/17/99 | Spring head | ** | 5.9 | 354.1 | ** | 0 |
| 8/17/99 | ½ mile d.g. | ** | 7.1 | 371.4 | **229.0** | **8,000** |
| Increases | | ** | 1.2 | 17.3 | (229.0) | 8,000 |
| 9/22/99 | Spring head | 14.5 | **4.0** | 347.5 | ** | 0 |
| 9/22/99 | ½ mile d.g. | 14.8 | 8.2 | 346.4 | **142 .0** | **5,000** |
| Increases | | 0.3 | 4.2 | -0.9 | (142.0) | 5,000 |

*= Returned from laboratory as "Too Numerous To Count"
**= Not analyzed
( )= Predicted increase

Major increases occur in turbidity and fecal coliform bacteria levels due to the presence of livestock. Turbidity and fecal coliform do not meet Class B or C standards. The increase from the spring head to downstream (Figure 16) indicates that cattle are causing significant disturbance to the spring. This dispersion of flow may be decreasing water quantity by evaporation and infiltration. Bank erosion is occurring directly at the spring head and may be reducing water quantity.

**Figure 15:Old Trough, just below spring head(9/15/99).** Concentrated grazing and trampling are disrupting natural flow.

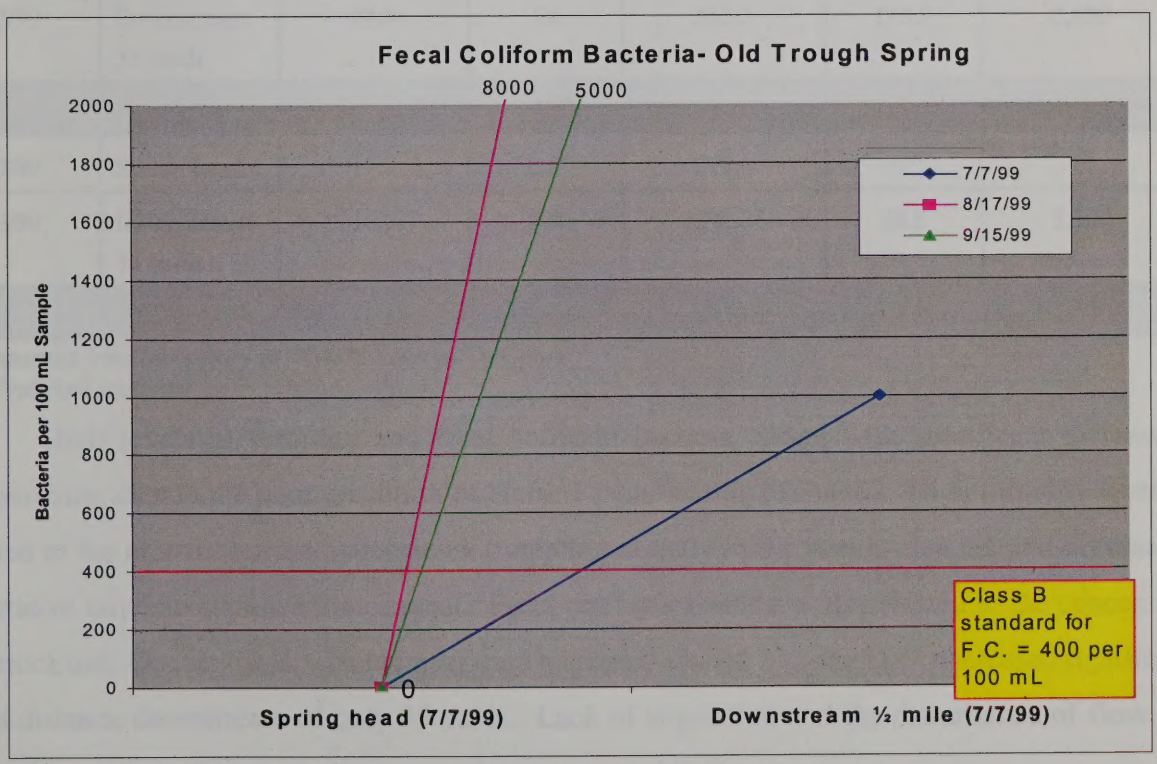



**Figure 16: Fecal Coliform Bacteria- Old Trough Spring.**

*Horse Pasture Spring*

This spring experienced intensive grazing throughout the summer of '99. Evidence of over-utilization of vegetation and extreme hummocking is readily apparent (Figures 17, 18). The spring head showed existing bank cutting from previous years of grazing. Compaction of the soil on the bank may be preventing reestablishment of riparian vegetation. Water cress and bluegrass cover the spring flow in early summer, providing shading and protection from ~~further~~ erosion. However, grazing over the summer significantly decreased vegetation, increased erosion and negatively affected water quality (Table8).

**Table 8: Horse Pasture spring parameters.**

| *Sampling Dates* | *Location* | *Water Temp. (°C)* | *Dissolved $O_2$ (mg/L)* | *Specific Cond. (µS/cm)* | *Turbidity (NTU)* | *Fecal Coliform Bacteria* |
|---|---|---|---|---|---|---|
| **Standards** | **Class B** | **24.0** | **>5.0** | **800.0** | **50.0** | **400** |
| 7/7/99 | Spring head | 18.4 | 6.3 | 180.1 | ** | ** |
| 7/7/99 | Downstream 35 yards | **28.0** | 5.7 | 312.3 | 16.0 | **TNTC** |
| Increase | | 9.6 | -0.6 | 132.2 | (16.0) | (1000*) |
| 8/17/99 | Spring head | 20.2 | 8.6 | 277.0 | ** | ** |
| 8/17/99 | Downstream 35 yards | **27.5** | 5.4 | 345.2 | **110.0** | **3,000** |
| Increase | | 7.3 | -3.2 | 68.2 | (110.0) | (3,000) |
| 9/22/99 | Spring head | 17.8 | 6.6 | 279.4 | ** | ** |
| 9/22/99 | Downstream 35 yards | 16.5 | 6.9 | 291.2 | **58.5** | **1,300** |
| Increase | | -1.3 | 0.3 | 11.8 | (58.5) | 1,300 |

*= Returned from laboratory as "Too Numerous To Count"
( )= Predicted increase

High levels of turbidity and fecal coliform bacteria, along with significant increases in temperature, dictate the poor condition of Horse Pasture spring (Table 8). High turbidity levels are related to the erosion caused by livestock trampling directly in the stream channel and decreases in vegetative cover to stabilize the channel. Fecal coliform levels are also related to the concentrated livestock use. On two dates, water temperature increased at least 7 °C and D.O. decreased significantly for a distance downstream of only 35 yards. Lack of vegetation and the disturbance of flow from trampling are contributors to changes in temperature and D.O..

**Figure 17 and 18: Horse Pasture spring on 6/10/99 (top) and 9/22/99 (bottom).** Earlier photo shows water cress covering spring flow and bank cutting that exists from previous years of grazing. After 3 months of grazing, vegetative cover has decreased significantly and grazing and trampling have increased hummocking and erosion in spring.

## 3. Effects of Trampling and Grazing

Concentrated trampling and grazing negatively affect entire watersheds, since disturbances to upland areas directly impact downstream water quality and stream channel integrity. Decreased vegetative cover and compaction of soils increase runoff during a rain event or snow melt, while promoting soil erosion and sediment production. This sediment is then delivered to stream flows where it causes increased turbidity and eventually the deposition of silt to stream beds. Sediments delivered to the stream affect aquatic life by inputting nutrients (causing eutrophication), fecal matter and other particles which can decrease oxygen content. Conversely, fully developed plants, with strong root systems, effectively retain soil integrity during storm events.

Riparian areas are extremely critical to watershed protection. They function in flood energy dissipation, sediment capture, groundwater recharge, nutrient cycling and maintenance of water quality (Fogg and Wells, 1998). In addition, riparian vegetation increase water storage capacity and prevent erosion by stabilizing soils. Proper function of riparian areas can be impaired by intensive grazing and trampling which decrease vegetation (eliminating sediment capture and water storage capacity), compact soil (decreasing infiltration) and disperse natural flows by hummocking and hoof depressions (causing water to flow shorter distances). Without functioning riparian areas, the health of watersheds are jeopardized. Water storage capacity and stabilized banks are essential in preventing erosion and head-cutting during flood events.

Furthermore, negative impacts to riparian zones can prevent these areas from being classified as wetlands (i.e. the Clean Water Act states that wetlands must contain all of the following: hydric soils, hydrophytic vegetation and presence of water). As vegetation is grazed and soils are trampled, the ability of the riparian ecosystems to store water disappears, lowering the water table. Dropping of the water table prevents hydrophytic vegetation from surviving; hence, the riparian area is no longer functioning, nor can it be classified as a wetland.

## MANAGEMENT OBJECTIVES AND BEST MANAGEMENT PRACTICES

Sound management practices will promote healthier upland vegetation and improve riparian conditions. These practices will directly improve quality and quantity of water and forage for livestock, wildlife, and wild horses. Surface water sources, in particular, are of great importance due to the lack of precipitation received throughout the summer months and the limited supply of overall surface water. These best management practices (BMPs) are required in order to meet the standards for Rangeland Health for the Northeastern Great Basin Resource Advisory Council (RAC) area and NDEP.

### 1. Management Objectives

1. Improve water quality parameters to meet or exceed NDEP standards.
2. Restore surface and sub-surface water sources to proper functioning condition.
3. Provide more forage for livestock, wildlife and wildhorses.
4. Protect riparian areas from erosion and overuse.
5. Provide an aesthetically pleasing environment for recreation.
6. Restore aquatic habitats and fisheries (where applicable).

### 2. Rangeland Health Standards

1. Upland soils exhibit infiltration and permeability rates that are appropriate to soil type, climate and land form.
   As indicated by:
   - Indicators are canopy and ground cover, including litter, live vegetation and rock, appropriate to the potential of the site.
2. Riparian and wetland areas exhibit properly functioning condition and achieve state water quality criteria.
   As indicated by:
   - Stream side riparian areas are functioning properly when adequate vegetation, large woody debris, and rock is present to dissipate stream energy associated with high water flows.
   - Natural springs, seeps, and marsh areas are functioning properly when adequate vegetation is present to facilitate water retention, filtering and release as indicated by plant species and cover appropriate to the site characteristics.
   - Chemical, physical and biological water constituents are not exceeding state water quality standards.
3. Habitats exhibit a healthy, productive, and diverse population of native and/or desirable plant species, appropriate to the site characteristics, to provide suitable feed, water, cover and living space for animal species and maintain ecological processes.
   As indicated by:
   - Vegetation composition (relative abundance of species);
   - Vegetation structure (life forms, cover, height, or age classes);
   - Vegetation distribution (patchiness, corridors);
   - Vegetation productivity and nutritional value.

## 3. Best Management Practices

These objectives and standards can be achieved by implementing BMPs through terms and conditions of grazing permits, leases, allotment management plans and range improvement activities. The following recommendations are generic BMPs that need to be implemented throughout the allotment. Site areas which are italicized in the recommendations will need site specific BMPs in order to accomplish improvements.

1. Rest or Closure

In some degraded systems, removal of livestock for a period of years followed, by a planned management program may allow recovery without permanent livestock exclusion (Fogg and Wells 1998). Areas grazed heavily and exhibiting very poor water quality (i.e. *Moss Creek watershed, Horse Pasture spring, Elephant Head spring* and *Old Trough spring*) require these measures as soon as possible to speed recovery by reestablishing riparian plants. Riparian pastures or stream sections need to be fenced from grazing by large herbivores until the area has met objectives and Rangeland Health standards. This will require long-term monitoring. Fenced stream sections may have water gaps which allow livestock access to the stream. Pastures which are fenced can have water piped to troughs on adjacent areas.

2. Rotational Grazing over Multiple Pastures

This method will discourage continual grazing of one pasture and allow vegetation to regenerate (i.e. *Pasture springs, Carico springs* and *Cottonwood Basin*). Seasonal rotation provides plants time to complete their growth cycle and set seed for regrowth, while annual rotations allow pastures to be rested periodically (Brodie, 1996). During seasonal rotation, livestock should be removed before the grazing season is over so vegetation is allowed to recover. Annual rotation can be much more stressful to plants than seasonal rotation, even with much smaller herd-sizes, since the vegetation is sometimes grazed past the point of regrowth. Both strategies can be ineffective if livestock are brought back to an area too early and limit plant production. Monitoring will be required with this method.

During rotational grazing, it is important to decide whether a riparian area is functioning or non-functioning. Functioning areas will be able to recover faster from livestock usage than non-functioning areas since they have better developed root systems.

3. Herding

This is an important practice to ensure that both upland and riparian areas are not over-grazed. This practice will require constant movement of livestock over an area to allow vegetation to recover and to prevent over-compaction of the soil. This technique will benefit livestock by moving them from areas with poor forage to higher quality forage.

4. Herd-size Restrictions

Limitations can be placed on the number of cattle allowed on the allotment. No practices will be effective if too many livestock are grazing an area. This can be accomplished through a reduction in AUM'S. Setting appropriate management levels for the wild horses in the two HMA's in the CLA is also necessary to provide for a thriving natural ecological balance with other multiple uses on the allotment.

5. Alternate Methods to Distribute Livestock

Placing salt or mineral blocks in upland areas can distribute cattle away from riparian areas.

Piping water to troughs, away from riparian areas, will redistribute livestock. It has been shown that providing a water trough may reduce in-stream fecal deposition by as much as 90 percent (Moore et al. 1993). Creating alternate water sources would require periodic, long-term maintenance.

6. Restoration and Protection of Riparian Areas

Additional measures can be taken to prevent erosion of stream banks and restoring native vegetation. Planting riparian vegetation will accelerate stabilization of stream banks, shade channels and reduce sediment / nutrient loading. Placing rocks and woody debris in stream beds and on stream banks can effectively reduce bank erosion.

Through the implementation of BMPs, these lands can be managed, in balance, to be both economically and environmentally viable. Meeting Rangeland Health Standards will be rewarded by providing improved habitat, water quality/quantity and forage with higher nutritional content. Last, but not least, the BLM's and NDEP's legal responsibilities, as mandated in the Clean Water Act to meet or exceed federal and state water quality standards will be facilitated.

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## APPENDIX A

**Class A water** is defined as waters or portions of waters which are located in areas of little human habitation, no industrial development or intensive agriculture and where the watershed is relatively undisturbed by man's activity. The beneficial uses of Class A waters are municipal or domestic supply, or both, with treatment by disinfection and filtration only, aquatic life, propagation of wildlife, irrigation, watering of livestock, recreation including contact with water and recreation not involving contact with the water. **Water quality standards for Class A waters are as follows:**

| ITEM | SPECIFICATIONS |
|---|---|
| a. Floating solids, sludge deposits, tastes or odor producing substances. | None attributable to man's activities |
| b. Sewage, industrial wastes or other | None |
| c. Toxic Materials, oil, deleterious substances ,colored or other wastes | None |
| d. Settleable Solids | Only amounts attributable to man's activities which will not make the waters unsafe or unsuitable as a drinking water source or which will not be detrimental to aquatic or for any other beneficial use established for this class. |
| e. pH | Range from 6.5 to 8.5. |
| f. Dissolved Oxygen | Must not be less than less than 6.0 mg/L |
| g. Temperature | Must not exceed 20°C. Allowable temperature increase above natural receiving water temperatures: none. |
| h. Fecal Coliform | The fecal coliform concentration, based on a minimum of 5 samples during any 30 day period, must not exceed a geometric mean of 200 per 100 millilitres, nor may more than 10 percent of total samples during any 30 day period exceed 400 per 100 millilitres. |
| i. Total phosphates | Must not exceed 0.15 mg/L in any stream at the point where it enters any reservoir or lake, nor .075 mg/L in any reservoir or lane, nor .30 mg/L in streams and other flowing waters. |
| j. Total Dissolved solids | Must not exceed 500 mg/L or one-third above that characteristic of natural conditions (whichever is less). |

**Class B water** is defined as waters or portions of waters which are located in areas of light or moderate human habitation, little industrial development, light-to-moderate development, and were the watershed is only moderately influenced by man's activity. The beneficial uses of Class B waters are municipal or domestic supply, or both, with treatment by disinfection and filtration only, irrigation, watering of livestock, aquatic life and propagation of wildlife, recreation involving contact with the water, recreation not involving contact with the water, and industrial supply. **Water quality standards for Class B waters are as follows:**

| ITEM | SPECIFICATIONS |
|---|---|
| a. Floating solids, settleable solids, or sludge deposits | Only such amounts attribute to man's activities which will not make the waters unsafe or unsuitable as a drinking water source, injurious to fish or wildlife or impair the waters for any other beneficial use established for this class. |
| b. Sewage, industrial wastes or other | None which are not effectively treated to the satisfaction of the department. |
| c. Odor-producing substances | Only such amounts which will not impair the palatability of drinking water or fish or have a deleterious effect upon fish, wildlife, or any beneficial uses established for waters of this class. |
| d. Toxic Materials, oil, deleterious substances colored or other wastes, or heated / cooled liquids. | Only such amounts as will not render the receiving water injurious to fish or wildlife or impair the receiving waters for any beneficial uses established for this class. |
| e. pH | Range from 6.5 to 8.5. |
| f. Dissolved Oxygen | For trout waters, not less than 6.0 mg/L; for non-trout waters, not less than 5.0 mg/L. |
| g. Temperature | Must not exceed 20°C for trout waters or 24°C for non-trout waters. Allowable temperature increase above natural receiving water temperatures: none. |
| h. Fecal Coliform | The fecal coliform concentration, based on a minimum of 5 samples during any 30 day period, must not exceed a geometric mean of 200 per 100 millilitres, nor may more than 10 percent of total samples during any 30 day period exceed 400 per 100 millilitres. |
| i. Total phosphates | Must not exceed 0.3 mg/L. |
| j. Total Dissolved solids | Must not exceed 500 mg/L or one-third above that characteristic of natural conditions (whichever is less). |

**Class C water** is defined as waters or portions of waters which are located in areas of moderate-to urban human habitation, where industrial development is present in moderate amounts, agricultural practices are intensive and where the watershed is considerably altered by man's activity. The beneficial uses of Class C waters are municipal or domestic supply, or both, following complete treatment, irrigation, watering of livestock, aquatic life, propagation of wildlife, recreation involving contact with the water, recreation not involving contact with the water, and industrial supply. **Water quality standards for Class C waters are as follows:**

| ITEM | SPECIFICATIONS |
|---|---|
| a. Floating solids, settleable solids, or sludge deposits | Only such amounts attribute to man's activities which will not make the receiving waters injurious to fish or wildlife or any other beneficial use established for this class. |
| b. Sewage, industrial wastes or other | None which are not effectively treated to the satisfaction of the department. |
| c. Toxic Materials, oil, deleterious substances colored or other wastes, or heated or cooled liquids. | Only such amounts as will not render the receiving water injurious to fish and wildlife or impair the waters for any beneficial uses established for this class. |
| d. pH | Range from 6.5 to 8.5. |
| e. Dissolved Oxygen | For waters with trout, not less than 6.0 mg/L; for non-trout waters, not less than 5.0 mg/L. |
| f. Temperature | Must not exceed 20°C for trout waters or 34°C for non-trout waters. Allowable temperature increase above natural receiving water temperatures: 3°C. |
| g. Fecal Coliform | The more stringent of the following apply:<br>1. The fecal coliform concentration must not exceed a geometric mean of 1000 per 100 millilitres, nor may more than 20 percent of total samples during any 30 day period exceed 2400 per 100 millilitres.<br>2. The annual geometric mean of the fecal coliform concentration must not exceed that characteristic of natural conditions by more than 200 per 100 milliliters nor may the number of fecal coliform in a single sample exceed that characteristic of natural conditions by more than 400 per 100 milliliters.<br>3. The Fecal coliform concentration, based on a minimum of 5 samples during any 30 day period, must not exceed a geomentric mean of 200 per 100 milliliters, nor may more than 10 percent of the total samples during any 30 day period exceed 400 per 100 milliliters. This is applicable only to those waters used for primary contact recreation. |
| h. Total phosphates | Must not exceed 1.0 mg/L. |
| i. Total Dissolved solids | Must not exceed 500 mg/L or one-third above that characteristic of natural conditions (whichever is less). |

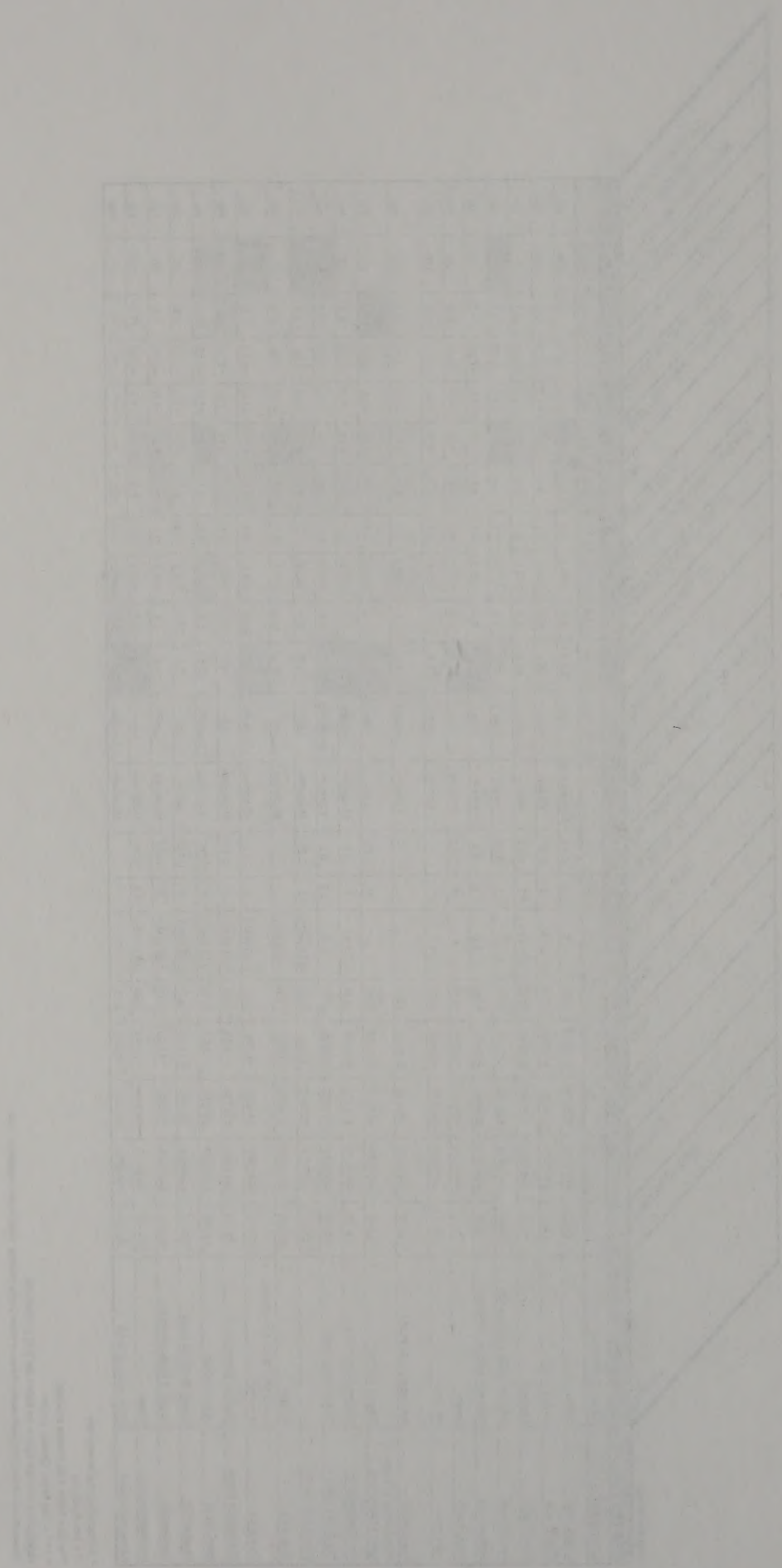
# APPENDIX B

## Table 9: Carico Lake Allotment- Sampling Period # 1 (Streams)

**County: Lander** **District: NV-060** **Dates: June 29, 1999 to July 21, 1999**

| Stream Name | Station | Site Designation | Northing | Easting | Date | Time | Discharge (cf/s) | Ave Width (ft) | Ave Depth (ft) | Riparian/ Streambank Condition | Turbidity | Water Temp. (deg. C) | Dissolved Oxygen (mg/L) | Specific Conductance (microS) | Salinity (ppt) | pH | Total Phosphorous (mg/L) | Nitrate Nitrogen (mg/L) | Ammonia Nitrogen (mg/L) | Lab Turbidity (NTU) **** | Fecal Coliform (per 100 ml sample) | Metals Analysis *** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *STANDARDS* | *Class B Water*[1] | | | | | | | | | | | *24.0* | *>5.0* | *800.0* | | *6.5-8.5* | *0.3* | *10.0* | | *50.0* | *400.0* | |
| *STANDARDS* | *Class C Water*[1] | | | | | | | | | | | *34.0* | *>5.0* | *800.0* | | *6.5-8.5* | *1.0* | *10.0* | | *100.0* | *1000.0* | |
| Elder Creek | Lower | Ck-1 | 4453710 | 515404 | 6/29/99 | 1030 | 0.5 | 2 | 0.17 | Mod-Heavy | Low | 22.4 | 6.5 | 518.0 | 0.3 | 9.0 | 0.56 | <1.0 | <0.05 | 1.8 | 240 | No |
| Elder Creek | Middle | Ck-2 | 4457771 | 513252 | 6/29/99 | 1115 | 0.75 | 3 | 0.25 | Heavy | Low | 18.9 | 6.3 | 264.2 | 0.1 | 8.4 | 2.20 | <1.0 | <0.05 | 2.3 | 220 | No |
| Elder Creek | Upper | Ck-3 | 4461326 | 513140 | 6/29/99 | 1210 | 0.25 (est.) | 2 | 0.17 | Heavy | Low | 18.9 | 6.3 | 264.0 | 0.1 | 7.9 | 2.20 | <1.0 | <0.05 | 0.4 | 0 | No |
| Ferris Creek | 100 yds. before confluence | Ck-4 | 4463405 | 520280 | 6/29/99 | 1300 | 3 | 3 | 0.25 | Heavy | Low | 20.9 | 9.4 | 417.5 | 0.2 | 8.4 | 0.89 | <1.0 | <0.05 | 0.9 | 410 | No |
| Indian Creek | 300 yds. before confluence | Ck-5 | 4463970 | 520933 | 6/29/99 | 1330 | 3.6 | 3 | 0.5 | Heavy | Low | 24.1 | 8.5 | 426.7 | 0.2 | 8.5 | 0.21 | <1.0 | <0.05 | 1.0 | 82 | No |
| Indian Creek | Lower | Ck-6 | 4464355 | 529273 | 6/29/99 | 1430 | 4 | 5 | 0.42 | Extreme | Low | 26.1 | 8.9 | 473.0 | 0.2 | 8.8 | 0.20 | <1.0 | <0.05 | 0.8 | 25 | No |
| Mill Creek | Rt. 305 | Ck-7 | 4469606 | 496370 | 6/29/99 | 1700 | 1.1 | | | Heavy | Low | 23.8 | 7.7 | 444.6 | 0.2 | 8.7 | 0.27 | <1.0 | <0.05 | 2.6 | 130 | No |
| Reese River | Antelope Valley Road | Ck-8 | 4428948 | 483016 | 6/30/99 | 1230 | * | | | Heavy | Extreme | 23.5 | 6.2 | 1539.0 | 0.8 | 8.9 | 1.10 | <1.0 | <0.05 | 10.0 | 28 | No |
| Reese River (7 miles south of allotment) | Gaging Station | Ck-9 | 4420275 | 487370 | 6/30/99 | 1300 | 6 | 10 | 0.25 | Low | High | 25.2 | 11.4 | 1682.0 | 0.8 | 8.7 | 1.90 | <1.0 | <0.05 | 61.4 | 144 | Yes |
| Fish Creek (upper) | Allotment Boundary | Ck-10 | 4449276 | 478375 | 6/30/99 | 1430 | 4.8 | 4 | 0.5 | Moderate | Moderate | 25.3 | 8.3 | 423.6 | 0.2 | 8.6 | 0.16 | <1.0 | <0.05 | 5.4 | 32 | No |
| Fish Creek (lower) | Just above private | Ck-11 | 4446612 | 483500 | 6/30/99 | 1530 | 5.9 | 3.5 | 0.5 | Extreme | Moderate | 27.2 | 8.1 | 476.3 | 0.2 | 8.8 | 0.14 | <1.0 | <0.05 | 14.0 | TNTC | No |
| Wilson Canyon Ck. | | Ck-12 | 4451213 | 505850 | 7/7/99 | 1030 | 0.25 (est.) | 2 | 0.25 | Moderate | Low | 19.5 | 9.0 | 463.8 | 0.2 | 8.8 | 3.20 | <1.0 | 0.06 | 3.8 | TNTC | No |
| Cook's Ck. | Middle | Ck-13 | 4452922 | 509270 | 7/7/99 | 1100 | 0.50 (est.) | | | Moderate | Low | 19.2 | 11.9 | 297.4 | 0.1 | 8.7 | 0.66 | <1.0 | 0.06 | 0.9 | 10 | No |
| Cook's Ck. | Lower (At Carico Lake Road crossing) | Ck-14 | 4448083 | 510030 | 7/7/99 | 1320 | 0.50 (est.) | 2 | 0.2 | Extreme | Extreme | 28.0 | 10.6 | 694.0 | 0.3 | 9.0 | 5.50 | <1.0 | <0.05 | 9.9 | TNTC | No |
| Cottonwood Creek | Close to stream head | Ck-15 | 4441984 | 498394 | 7/14/99 | 1000 | 0.75 (est.) | 2 | 0.25 | Moderate | High | 14.3 | 11.1 | 288.2 | 0.1 | 8.7 | 0.15 | 2.9 | <0.05 | 180.1 | 1500 | No |
| Moss Creek | Upper section | Ck-16 | 4450500 | 497650 | 7/14/99 | 1315 | 2.00 (est.) | 2 | 0.167 | Extreme | Extreme | 20.0 | 8.3 | 1141.0 | 0.6 | 8.1 | 0.52 | <1.0 | <0.05 | 263.0 | 20000 | No |
| Wenban Ck. | Lower, first road cross | Ck-17 | 4440663 | 523480 | 7/14/99 | 1430 | 0.50 (est.) | 2 | 0.167 | Heavy | Low | 17.5 | 10.6 | 673.0 | 0.3 | 8.3 | 0.07 | <1.0 | <0.05 | 1.9 | 48 | No |
| Wenban Ck. | Upper, 2 miles upstream | Ck-18 | 4438348 | 525830 | 7/14/99 | 1515 | 0.25 (est.) | 1 | 0.167 | Moderate | Low | 19.2 | 9.5 | 368.7 | 0.2 | 8.7 | 3.50 | <1.0 | <0.05 | 1.8 | 50 | No |
| Elephant Head Ck. | Lower | Ck-19 | 4436670 | 500568 | 7/21/99 | 1430 | 0.50 (est.) | 1.5 | 0.25 | Moderate | Low | 28.5 | 5.7 | 360.4 | 0.2 | 8.0 | 2.80 | <1.0 | <0.05 | 27.9 | 152 | No |
| Cortez mine pond | North, close to road | Pond-1 | 4450705 | 521943 | 7/20/99 | 930 | * | | | Moderate | Moderate | 29.4 | 3.8 | 843.0 | 0.4 | 7.8 | ** | ** | ** | ** | ** | Yes |

* = Flow too small to estimate
** = Not Analyzed
***= See Table 3 for metals analysis
**** = See Water Quality section
Highlighted cells are above (or below for D.O.) standards.
[1] Nevada Division of Environmental Protection: Bureau of Water Quality Planning. Water Quality Regulations. 1998



## Table 10: Carico Lake Allotment- Sampling Period # 1 (Springs)

**County: Lander** **District: NV-O60** **Dates: June 29, 1999 to July 21, 1999**

| Spring Name | Station | Site Designation | Northing | Easting | Date | Time | Discharge (cf/s) | Riparian/ Streambank Condition | Turbidity | Water Temp. (dg. C) | Dissolved Oxygen (mg/L) | Specific Conductance (microS) | Salinity (ppt) | pH | Total Phosphorus (mg/L) | Nitrate Nitrogen (mg/L) | Ammonia Nitrogen (mg/L) | Lab Turbidity (NTU) **** | Fecal Coliform (per 100ml sample) | Metals Analysis *** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *STANDARDS* | *Class B Waters*[1] | | | | | | | | | *24.0* | *>5.0* | *800.0* | | *6.5-8.5* | *0.3* | *10.0* | | *50.0* | *400* | |
| *STANDARDS* | *Class C Waters*[1] | | | | | | | | | *34.0* | *>5.0* | *800.0* | | *6.5-8.5* | *1.0* | *10.0* | | *100.0* | *1000.0* | |
| | Copper Canyon | Sp-1 | 4446218 | 530750 | 6/29/99 | 930 | 0.25 (est.) | Low | Low | 14.9 | 5.3 | 837.0 | 0.4 | 8.1 | 2.60 | <1.0 | <0.05 | 0.4 | 18 | Yes |
| Hole in the Wall Sp. | Spring head | Sp-2 | 4459272 | 516100 | 6/29/99 | 1530 | * | Extreme | Low | 12.5 | 3.1 | 683.0 | 0.3 | 6.8 | ** | ** | ** | ** | 2 | No |
| Hole in the Wall Sp. | Pond | Sp-3 | 4459272 | 516100 | 6/29/99 | 1530 | * | Extreme | Extreme | 29.6 | 0.2 | 1,690.0 | 0.8 | 7.2 | ** | ** | ** | ** | 2500 | No |
| Greystone Spring | Greystone Mine | Sp-4 | 4456330 | 510784 | 6/29/99 | 1600 | 0.10 (est.) | Moderate | Low | 9.8 | 9.5 | 1,344.0 | 0.7 | 7.4 | 1.30 | <1.0 | <0.05 | 0.2 | 23 | Yes |
| | South of Greystone | Sp-5 | 4455899 | 511025 | 6/29/99 | 1630 | * | Extreme | Extreme | 28.9 | 6.7 | 1,032.0 | 0.5 | 8.1 | 0.58 | ** | <0.05 | ** | TNTC | No |
| Bridge's Well | Well head | Sp-6 | 4432710 | 483200 | 6/30/99 | 1330 | 0.05 (est.) | Extreme | Low | 13.6 | 10.7 | 1,384.0 | 0.7 | 7.5 | 0.17 | 1.8 | <0.05 | 0.4 | 0 | No |
| Bridge's Well | Pond | Sp-7 | 4432710 | 483200 | 6/30/99 | 1330 | 0.05 (est.) | Extreme | Extreme | 25.2 | 8.9 | 1,669.0 | 0.8 | 8.9 | 0.69 | <1.0 | <0.05 | 24.0 | 88 | No |
| Cedar's Spring | Spring head | Sp-8 | 4435960 | 490400 | 6/30/99 | 1430 | 0.12 (est.) | Extreme | Extreme | 30.5 | 6.6 | 811.0 | 0.4 | 7.6 | 0.28 | <1.0 | <0.05 | 0.0 | 0 | No |
| Cedar's Spring | Pond outlet | Sp-9 | 4435960 | 490400 | 6/30/99 | 1430 | 0.12 (est.) | Extreme | Low | 24.4 | 10.5 | 865.0 | 0.4 | 8.4 | 1.60 | <1.0 | <0.05 | 407.0 | TNTC | No |
| Fish Creek Sp. | | Sp-10 | 4449005 | 478205 | 6/30/99 | 1600 | 0.25 (est.) | Heavy | Low | 31.0 | 4.6 | 410.1 | 0.2 | 7.7 | 7.90 | <1.0 | <0.05 | 44.0 | 98 | No |
| Old Trough Spring | East of Smith Flat | Sp-11 | 4451017 | 501681 | 7/7/99 | 900 | 0.25 (est.) | Extreme | High | 17.7 | 8.2 | 216.7 | 0.1 | 8.1 | 0.48 | <1.0 | 0.06 | 148.0 | TNTC | No |
| Old Trough Spring | Spring heads | Sp-11a | 4450829 | 502019 | 7/7/99 | 930 | 0.05 (est.) | Extreme | Low | 14.6 | 5.1 | 322.6 | 0.2 | 7.0 | ** | ** | ** | ** | ** | No |
| Horse Pasture Sp. | 35 yds. Downstream | Sp-12 | 4447870 | 508931 | 7/7/99 | 1230 | 0.15 (est.) | Extreme | Low | 28.0 | 5.7 | 312.3 | 0.2 | 7.4 | 1.80 | <1.0 | 0.04 | 16.0 | TNTC | No |
| Horse Pasture Sp. | 4 yds. below heads | Sp-12a | 4447870 | 508931 | 7/7/99 | 1230 | 0.15 (est.) | Extreme | Low | 21.1 | 7.0 | 287.5 | 0.1 | 7.4 | ** | ** | ** | ** | ** | No |
| Horse Pasture Sp. | Spring head | Sp-12b | 4447870 | 508931 | 7/7/99 | 1230 | 0.15 (est.) | Extreme | Low | 18.4 | 6.3 | 180.1 | 0.1 | 7.4 | ** | ** | ** | ** | ** | No |
| Dry Gulch Spring | Upper Seap | Sp-13 | 4415169 | 518268 | 7/7/99 | 1500 | * | Extreme | High | 28.7 | 3.7 | 315.4 | 0.2 | 8.5 | 3.30 | <1.0 | 0.81 | 282.0 | TNTC | No |
| Dry Gulch Spring | Lower Seap | Sp-14 | 4415169 | 518268 | 7/7/99 | 1500 | * | Extreme | Extreme | 27.7 | 2.1 | 840.0 | 0.4 | 7.7 | 0.79 | <1.0 | 0.58 | 101.0 | TNTC | No |
| Exclosure spring | 70 yds. below head | Sp-15 | 4441480 | 498097 | 7/14/99 | 1015 | 0.25 (est.) | Low | Low | 12.3 | 9.1 | 120.4 | 0.1 | 7.7 | 0.12 | 6.3 | <0.05 | 12.9 | 400 | No |
| Exclosure spring | Spring head | Sp-15a | 4441307 | 498019 | 7/14/99 | 1100 | 0.25 (est.) | Low | Low | 9.5 | 8.2 | 169.9 | 0.1 | 6.9 | ** | ** | ** | ** | ** | No |
| Outside exclosure | 70 yds. below head | Sp-16 | 4441481 | 498020 | 7/14/99 | 1030 | 0.25 (est.) | Extreme | High | 13.8 | 10.0 | 226.6 | 0.1 | 8.1 | 0.19 | 3.7 | <0.05 | 35.2 | 3000 | No |
| Outside exclosure | Spring head | Sp-16a | 4441314 | 497984 | 7/14/99 | 1045 | 0.25 (est.) | Extreme | High | 8.0 | 10.9 | 206.2 | 0.1 | 7.0 | ** | ** | ** | ** | ** | No |
| Orange rock spring | Spring head | Sp-17 | 4450645 | 498200 | 7/14/99 | 1300 | 0.10 (est.) | Extreme | Low | 9.2 | 4.9 | 1,133.0 | 0.6 | 7.4 | 0.41 | <1.0 | <0.05 | 1.2 | 0 | No |
| Carico Springs | North section, in pond | Sp-18 | 4443395 | 510233 | 7/14/99 | 1600 | * | Extreme | Extreme | 28.7 | 4.6 | 872.0 | 0.4 | 8.0 | 0.17 | <1.0 | <0.05 | 139.0 | 20000 | No |
| Pasture spring | 70 yds. Below head | Sp-19 | 4442087 | 527044 | 7/21/99 | 930 | 0.10 (est.) | Extreme | High | 18.1 | 7.2 | 427.5 | 0.2 | 7.9 | 2.70 | <1.0 | <0.05 | 165.0 | 128 | No |
| Pasture spring | Spring head | Sp-20 | 4442102 | 527146 | 7/21/99 | 945 | 0.15 (est.) | Extreme | Low | 14.4 | 7.1 | 426.9 | 0.2 | 7.9 | 3.10 | <1.0 | <0.05 | 15.1 | 0 | No |
| Canyon spring | Up in canyon 30 yds. | Sp-21 | 4444597 | 527401 | 7/21/99 | 1100 | 0.10 (est.) | Low | Low | 14.8 | 10.6 | 700.0 | 0.3 | 8.4 | 0.06 | <1.0 | <0.05 | 2.5 | 0 | No |
| Wilson springs | Stream of springs | Sp-22 | 4436377 | 523540 | 7/21/99 | 1330 | 0.25 (est.) | Heavy | Low | 19.5 | 8.4 | 435.0 | 0.2 | 8.2 | 0.31 | <1.0 | <0.05 | 5.8 | 400 | No |
| Wilson spring | Eastward spring | Sp-22a | 4436348 | 523507 | 7/21/99 | 1300 | * | Extreme | Moderate | 17.9 | 4.1 | 513.0 | 0.2 | 7.1 | ** | ** | ** | ** | ** | No |
| Wilson spring | Westward spring | Sp-22b | 4436377 | 523540 | 7/21/99 | 1315 | * | Extreme | High | 25.8 | 4.6 | 624.0 | 0.3 | 7.9 | ** | ** | ** | ** | ** | No |
| Elephant head spring | Downstream 40 yds. | Sp-23 | 4438647 | 500967 | 7/21/99 | 1645 | * | Extreme | High | 26.6 | 0.0 | 347.2 | 0.2 | 7.2 | 1.30 | <1.0 | <0.05 | 724.0 | 600 | No |
| Elephant head spring | Spring head | Sp-23a | 4438647 | 500967 | 7/21/99 | 1630 | * | Extreme | Moderate | 18.7 | 6.0 | 109.3 | 0.1 | 7.3 | ** | ** | ** | ** | ** | No |

* = Flow too small to estimate

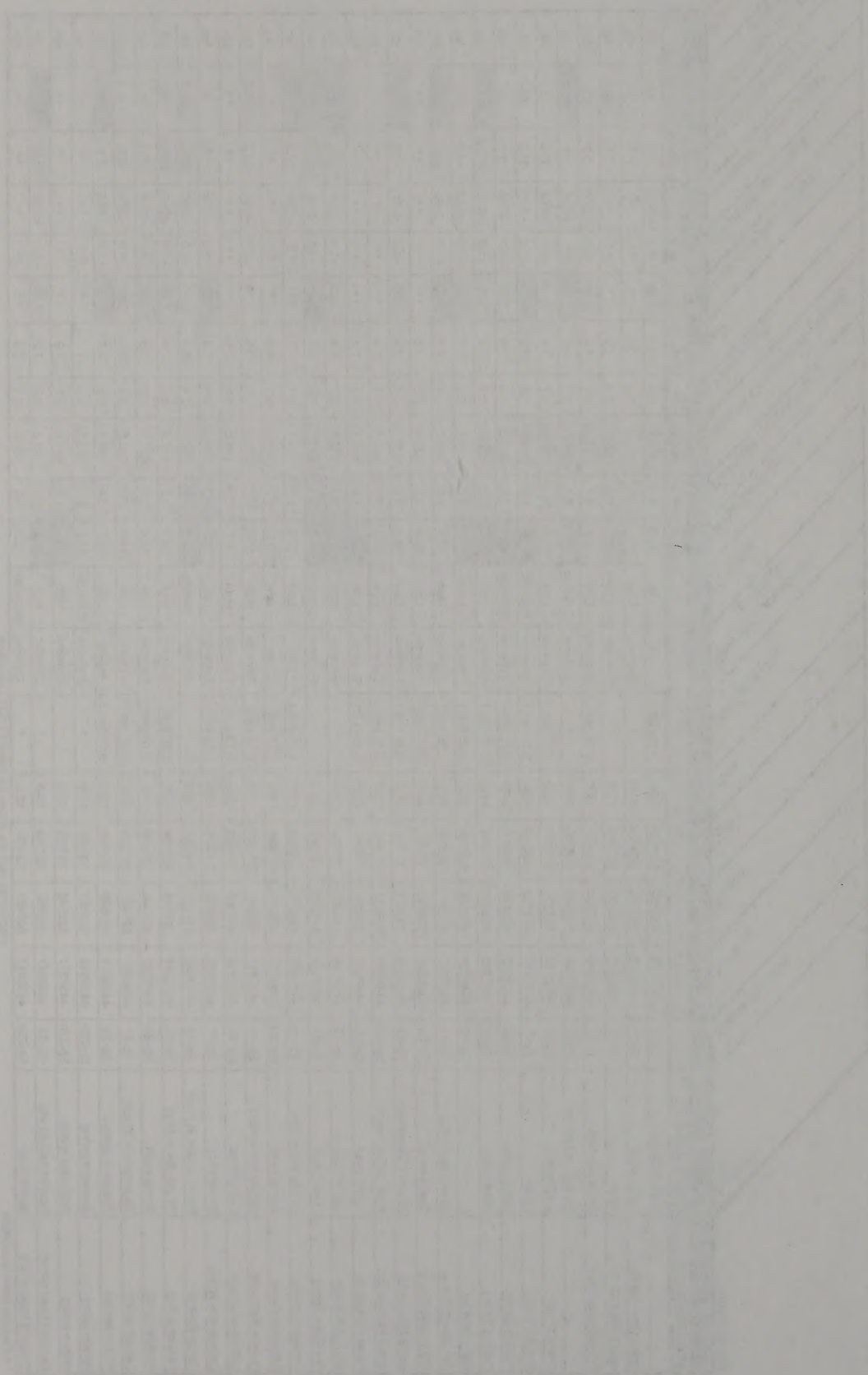
** = Not analyzed

***= See Table 3 for metals analysis

**** = See Water Quality section

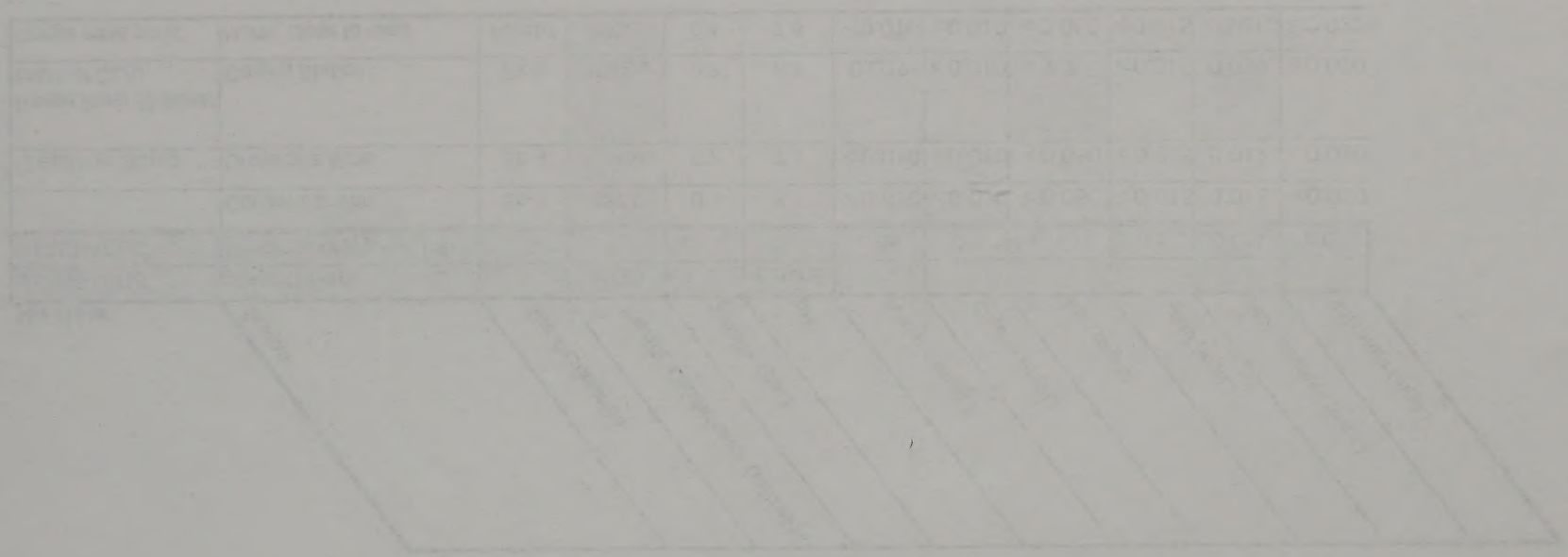
Highlighted cells are above (or below for D.O.) standards.

[1] Nevada Division of Environmental Protection: Bureau of Water Quality Planning. Water Quality Regulations. 1998.



## Table 11: Carico Lake Allotment: Metals Analysis

| Site Name | Station | Site Designation | Specific Conductance (microS) | Salinity (ppt) | pH | Arsenic (mg/L) | Copper (mg/L) | Iron (mg/L) | Lead (mg/L) | Molybdenum (mg/L) | Selenium (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *STANDARDS* | *Class C Water*[1] | | *800.0* | | *6.5-8.5* | | | | | | |
| *STANDARDS* | *Livestock or Aquatic Life*[1] | | | | | *0.05* | *0.5* | *1* | *0.1* | *0.019* | *0.05* |
| | Copper Canyon | Sp-1 | 837.0 | 0.4 | 8.1 | <0.010 | <0.010 | <0.050 | <0.015 | 0.018 | <0.020 |
| Greystone Spring | Greystone Mine | Sp-4 | 1,344.0 | 0.7 | 7.4 | <0.010 | <0.010 | <0.050 | <0.015 | 0.017 | <0.020 |
| Reese River (7 miles south of CLA) | Gaging Station | Ck-9 | 1682.0 | 0.8 | 8.7 | 0.029 | <0.010 | 2.7 | <0.015 | 0.039 | <0.020 |
| Cortez mine pond | North, close to road | Pond-1 | 843.0 | 0.4 | 7.8 | <0.010 | <0.010 | <0.050 | <0.015 | <0.010 | <0.020 |



## Table 12: Carico Lake Allotment- Sampling Period # 2 (Streams and Springs)

**County: Lander** **District: NV-060** **Dates: August 17, 1999 to August 31, 1999**

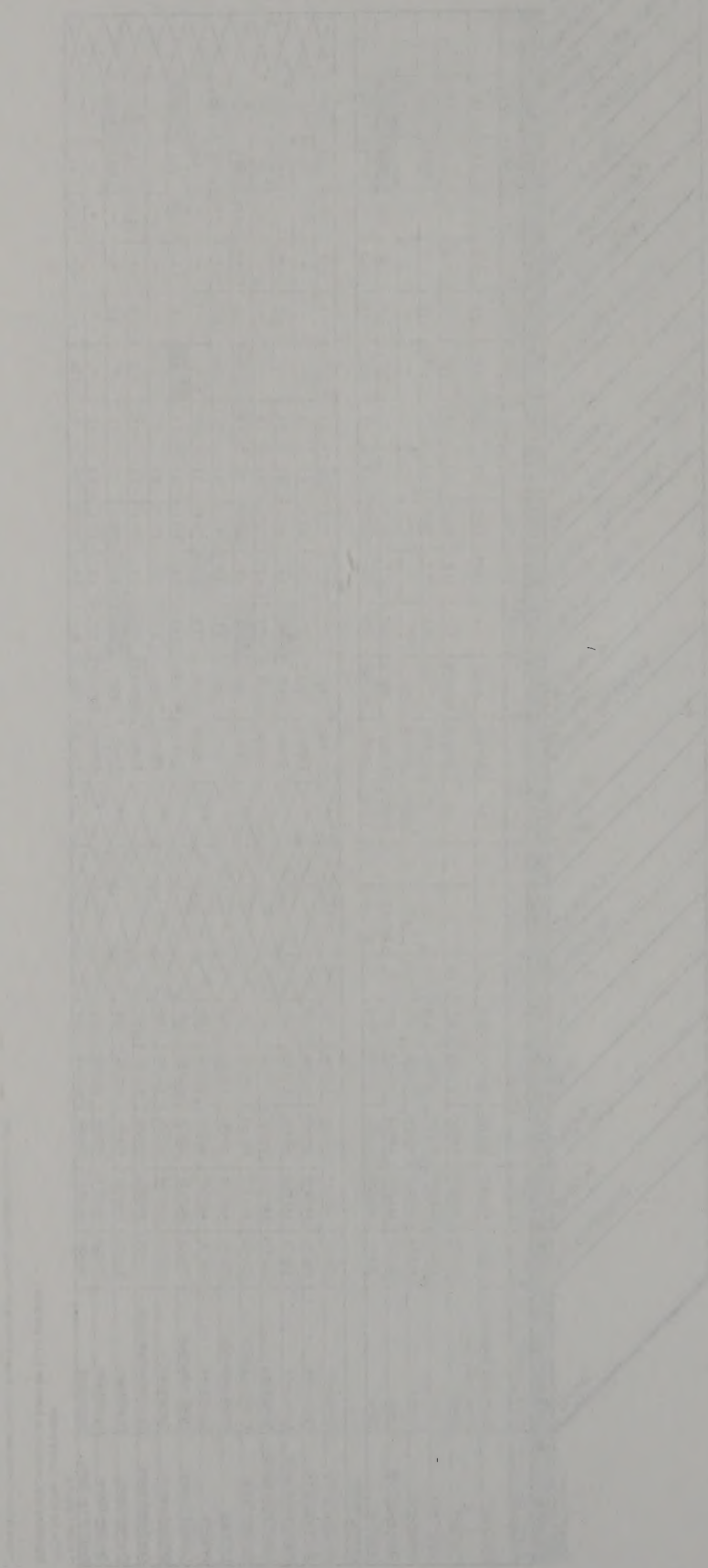
| Stream Name | Station | Site Designation | Northing | Easting | Date | Time | Gradient (%) | Discharge (cfs) | Width (ft) | Depth (ft) | Riparian/ Streambank Condition | Turbidity | Water Temp. (dg. C) | Dissolved Oxygen (mg/L) | Specific Conductance (microS) | Salinity (ppt) | pH | Total Phosphorus (mg/L) | Nitrate Nitrogen(mg/L) | Nitrite Nitrogen (mg/L) | Ammonia (mg/L) | Lab Turbidity (NTU) *** | Fecal Coliform (per 100 ml sample) | Biological Oxygen Demand (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *STANDARDS* | *Class B Waters* | | | | | | | | | | | | *24.0* | *>5.0* | *800.0* | | *6.5-8.5* | *0.3* | *10.0* | | | *50.0* | *400* | |
| *STANDARDS* | *Class C Water*[1] | | | | | | | | | | | | *34.0* | *>5.0* | *800.0* | | *6.5-8.5* | *1.00* | *10.0* | | | 100.0 | *1000* | |
| Fish Creek | Upper (allot. Boundary) | 2CK-10 | 4449392 | 478375 | 8/17/99 | 1015 | 1 | 3 | 3 | 0.5 | Extreme | Low | 11.9 | 13.6 | 538.0 | 0.3 | 8.6 | <0.01 | <1.0 | <0.01 | ** | 2.6 | 78 | <3 |
| Fish Creek | Lower Section (above private) | 2CK-11 | 4446467 | 483500 | 8/17/99 | 930 | 0.5 | 3 | 3 | 0.5 | Extreme | Moderate | 13.1 | 11.8 | 566.0 | 0.3 | 8.7 | 0.02 | <1.0 | <0.01 | ** | 2.9 | 376 | <6 |
| Cook's Creek | Lower | 2CK-14 | 4448079 | 510030 | 8/17/99 | 1335 | 0.5 | 0.5 | 2 | 0.1667 | Extreme | High | 28.1 | 14.1 | 726.0 | 0.4 | 9.3 | 5.67 | <1.0 | 0.02 | ** | 101.0 | 8,000 | 3 |
| Cook's Creek | Lower | 2CK-14 | 4448079 | 510030 | 8/25/99 | 1200 | 0.5 | 0.5 | 2 | 0.1667 | Extreme | High | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | 19,000 | ** |
| Cottonwood Creek | Upper | 2CK-15 | 4441984 | 498394 | 8/31/99 | 1015 | 2 | 0.25 (est.) | 1 | 0.1667 | Extreme | High | 11.8 | 11.5 | 242.5 | 0.1 | 8.3 | 0.11 | 3.9 | 0.02 | <0.05 | 59.0 | 600 | ** |
| Moss Creek | Upper | 2Ck-16 | 4450500 | 497650 | 8/17/99 | 1215 | 1 | 0.75 (est.) | 2 | 0.1667 | Extreme | Extreme | 22.6 | 7.6 | 1,152.0 | 0.6 | 8.1 | 3.20 | <1.0 | <0.01 | ** | 513.0 | 1,000 | <3 |
| **Spring Name** | | | | | | | | | | | | | | | | | | | | | | | | |
| Old Trough Spring | Downstream | 2Sp-11 | 4451017 | 501681 | 8/17/99 | 1300 | | | | | Extreme | High | ** | 7.1 | 371.4 | 0.2 | 7.9 | 3.40 | <1.0 | 0.06 | ** | 229.0 | 8,000 | |
| Old Trough Spring | Spring head | 2Sp-11a | 4450829 | 502019 | 8/17/99 | 1310 | | | | | Extreme | Low | ** | 5.9 | 354.1 | 0.2 | 7.4 | ** | ** | ** | ** | ** | 0 | |
| Horse Pasture Spring | Below pond | 2Sp-12 | 4447722 | 508931 | 8/17/99 | 1400 | | | | | Extreme | High | 27.5 | 5.4 | 345.2 | 0.2 | 7.7 | 0.14 | <1.0 | <0.05 | ** | 110.0 | 3,000 | |
| Horse Pasture Spring | Spring head | 2Sp-12a | 4447722 | 508931 | 8/17/99 | 1410 | | | | | Extreme | Low | 20.2 | 8.6 | 277.0 | 0.1 | 7.6 | ** | ** | ** | ** | ** | ** | |
| Dry Gulch Spring | Below pond and springs | 2Sp-13 | 4415127 | 518268 | 8/25/99 | 1330 | | | | | Extreme | High | 29.8 | 5.3 | 997.0 | 0.5 | 9.4 | 2.20 | <1.0 | ** | <0.05 | 486.0 | 320,000 | |
| Exclosure | 70 yds. below head | 2Sp-15 | 4441480 | 498097 | 8/31/99 | 1045 | | | | | Low | Low | 9.7 | 11.0 | 197.1 | 0.1 | 7.1 | <0.05 | 6.9 | <0.01 | <0.05 | 0.5 | 660 | |
| Exclosure | Spring head | 2Sp-15a | 4441307 | 498019 | 8/31/99 | 1055 | | | | | Moderate | Low | 12.0 | 3.7 | 104.6 | 0.1 | 7.1 | ** | ** | ** | ** | ** | ** | |
| Outside Exclosure | 70 yds. below head | 2Sp-16 | 4441481 | 498020 | 8/31/99 | 1050 | | | | | Extreme | Moderate | 13.5 | 7.3 | 218.2 | 0.1 | 7.9 | 0.36 | 2.8 | 0.04 | <0.05 | 21.0 | 600 | |
| Outside Exclusure | Spring head | 2Sp-16a | 4441314 | 497984 | 8/31/99 | 1100 | | | | | Extreme | Low | 8.5 | 8.4 | 217.7 | 0.1 | 7.1 | ** | ** | ** | ** | ** | ** | |
| Cow Scratch Spring | Downstream from heads | 2Sp-24 | 4443872 | 499499 | 8/31/99 | 1220 | | | | | Extreme | Moderate | 18.0 | 7.4 | 418.4 | 0.2 | 8.0 | 0.22 | <1.0 | 0.01 | <0.05 | 11.3 | 1,900 | |
| One Horn Spring | Downstream | 2Sp-25 | 4447335 | 499691 | 8/31/99 | 1345 | | | | | Extreme | High | 24.6 | 4.1 | 550.0 | 0.3 | 7.8 | ** | <1.0 | ** | ** | 242.0 | 25,000 | |
| One Horn Spring | Spring head | 2Sp-25a | 4447276 | 499855 | 8/31/99 | 1330 | | | | | Extreme | Moderate | 18.0 | 8.8 | 389.6 | 0.2 | 7.6 | ** | ** | ** | ** | ** | ** | |
| Beef Bull Yon Spring | Spring head | 2Sp-26 | 4423937 | 516364 | 8/31/99 | 1530 | | | | | Extreme | Low | 23.9 | 9.8 | 970.0 | 0.5 | 7.6 | 0.28 | <1.0 | <0.01 | <0.05 | 5.2 | 0 | |

** = Not Analyzed

*** = See Water Quality section

Highlighted cells are above (or below for D.O.) standards

[1] Nevada Division of Environmental Protection: Bureau of Water Quality Planning. Water Quality Regulations. 1998.



## Table 13: Carico Lake Allotment- Sampling Period # 3 (Streams and Springs)

County: Lander District: NV-060 Dates: September 15, 1999 to September 22, 1999

| Stream Name | Station | Site Designation | Northing | Easting | Date | Time | Gradient (%) | Discharge (cf/s) | Ave Width (ft) | Ave Depth (ft) | Riparian/ Streambank Condition | Turbidity | Water Temperature (deg. C) | Dissolved Oxygen (mg/L) | Specific Conductance (microS) | Salinity (ppt) | pH | Total Phosphorus (mg/L) | Nitrate Nitrogen (mg/L) | Nitrite Nitrogen (mg/L) | Ammonia Nitrogen (mg/L) | Lab Turbidity (NTU) *** | Fecal Coliform (per 100 ml Sample) | Biological Oxygen Demand (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *STANDARDS* | *Class B Waters*[1] | | | | | | | | | | | | *24.0* | *>5.0* | *800.0* | | *6.5-8.5* | *0.3* | *10.0* | | | *50.0* | *400* | |
| *STANDARDS* | *Class C Waters*[1] | | | | | | | | | | | | *34.0* | *>5.0* | *800.0* | | *6.5-8.5* | *1.0* | *10.0* | | | 100.0 | *1000* | |
| Elder Creek | Middle | 3Ck-2 | 4457771 | 513252 | 9/15/99 | 1450 | 1.5 | 0.35 (est.) | 1.5 | 0.16 | Heavy | Moderate | 19.3 | 7.5 | 500.0 | 0.2 | 8.4 | 0.16 | <1.0 | <0.01 | <0.05 | 2.0 | 16 | ** |
| Ferris Creek | | 3Ck-4 | 4463405 | 520280 | 9/15/99 | 1010 | 1 | 0.5 | 1 | 0.25 | Heavy | Low | 14.8 | 9.7 | 472.2 | 0.2 | 8.1 | 0.07 | <1.0 | <0.01 | <0.05 | 1.6 | 0 | ** |
| Indian Creek | Road west of Rt. 305 | 3Ck-6 | 4464387 | 529273 | 9/15/99 | 1030 | 0.5 | 0.66 | 2 | 0.33 | Extreme | Low | 18.8 | 14.9 | 452.3 | 0.2 | 9.4 | 0.15 | <1.0 | <0.01 | <0.05 | 1.0 | 190 | ** |
| Fish Creek | Upper | 3Ck-10 | 4449366 | 478373 | 9/22/99 | 1405 | 1.5 | 3 (est.) | 3 | 0.5 | Heavy | Low | 15.8 | 8.8 | 548.0 | 0.3 | 8.8 | 0.13 | <1.0 | <0.01 | <0.05 | 3.3 | 92 | <6 |
| Fish Creek | Lower | 3Ck-11 | 4446635 | 483365 | 9/22/99 | 1320 | 1 | 3 (est.) | 3 | 0.5 | Extreme | Low | 16.5 | 8.2 | 565.0 | 0.3 | 8.8 | 0.05 | <1.0 | <0.01 | <0.05 | 1.7 | 400 | <6 |
| Cook's Creek | Lower | 3Ck-14 | 4448083 | 510030 | 9/22/99 | 1115 | 1 | 0.5 (est.) | 2 | 0.16 | Extreme | Moderate | 14.6 | 11.3 | 697.0 | 0.3 | 8.9 | 0.34 | <1.0 | <0.01 | <0.05 | 62.6 | 2,000 | ** |
| Moss Creek | Upper | 3Ck-16 | 4450500 | 497879 | 9/22/99 | 1215 | 0.5 | 0.5 (est.) | 1 | 0.16 | Extreme | High | 14.3 | 7.9 | 1,116.0 | 0.6 | 7.9 | 0.23 | <1.0 | <0.01 | <0.05 | 157.0 | 200 | ** |
| Harry Canyon Creek | Middle | 3Ck-20 | 4463247 | 501071 | 9/22/99 | 1530 | 1 | 3 (est.) | 2 | 0.5 | Heavy | Low | 12.8 | 8.8 | 579.0 | 0.3 | 7.7 | 0.10 | <1.0 | <0.01 | <0.05 | 3.4 | 56 | ** |
| **Spring Name** | | | | | | | | | | | | | | | | | | | | | | | | |
| Greystone Spring | 100 yds. below heads | 3Sp-4 | 4456330 | 510784 | 9/15/99 | 1600 | | 0.20 (est.) | | | Heavy | Low | 19.9 | 5.9 | 1,678.0 | 0.9 | 8.3 | 0.09 | <1.0 | <0.01 | <0.05 | 0.0 | 112 | ** |
| South of Greystone | | 3Sp-5 | 4455900 | 511025 | 9/15/99 | 1530 | | * | | | Extreme | High | 21.0 | 2.3 | 890.0 | 0.4 | 7.6 | 0.16 | <1.0 | <0.01 | <0.05 | 0.0 | 0 | ** |
| Pasture Springs | At fence | 3Sp-19 | 4442056 | 527019 | 9/15/99 | 1315 | | 0.20 (est.) | | | Heavy | Moderate | 22.8 | 4.1 | 573.4 | 0.3 | 7.8 | 0.14 | <1.0 | <0.01 | <0.05 | 159.0 | 16 | ** |
| Pasture Springs | Spring head | 3Sp-20 | 4442121 | 527170 | 9/15/99 | 1325 | | 0.15 (est.) | | | Heavy | Low | 13.6 | 6.1 | 399.3 | 0.2 | 7.8 | ** | ** | ** | ** | ** | ** | ** |
| Canyon Spring | Up canyon 30 yds. | 3Sp-21 | 4444755 | 527452 | 9/15/99 | 1230 | | 0.15 (est.) | | | Low | Low | 16.9 | 5.0 | 453.6 | 0.2 | 8.0 | 0.10 | <1.0 | <0.01 | <0.05 | 0.8 | 2 | ** |
| Fish Creek Spring | 60 yds. below heads | 3Sp-10 | 4449015 | 478205 | 9/22/99 | 1400 | | 0.35 (est.) | | | Mod-heavy | Low | 25.1 | 5.8 | 392.0 | 0.2 | 7.7 | <0.05 | <1.0 | <0.01 | <0.05 | 2.0 | 0 | ** |
| Old Trough Spring | Spring head | 3Sp-11a | 4450832 | 501976 | 9/22/99 | 1140 | | 0.20 (est.) | | | Extreme | Low | 14.5 | 4.0 | 347.5 | 0.2 | 7.2 | ** | ** | ** | ** | ** | 0 | ** |
| Old Trough Spring | 400 yds. downstream | 3Sp-11 | 4451086 | 501487 | 9/22/99 | 1150 | | 0.20 (est.) | | | Heavy | Heavy | 14.8 | 8.2 | 346.4 | 0.2 | 8.2 | 0.21 | <1.0 | 0.02 | <0.05 | 142.0 | 5,000 | ** |
| Horse Pasture Spring | 75 yds. downstream | 3Sp-12 | 4447793 | 509037 | 9/22/99 | 1045 | | 0.15 (est.) | | | Extreme | Moderate | 16.5 | 6.9 | 291.2 | 0.1 | 7.7 | <0.05 | <1.0 | <0.01 | <0.05 | 58.5 | 1,300 | ** |
| Horse Pasture Spring | Spring head | 3Sp-12a | 4447793 | 509037 | 9/22/99 | 1055 | | 0.15 (est.) | | | Extreme | Low | 17.8 | 6.6 | 279.4 | 0.1 | 7.5 | ** | ** | ** | ** | ** | ** | ** |
| Ferris Springs | Flow into creek | 3Sp-27 | 4463171 | 519927 | 9/15/99 | 940 | | * | | | Extreme | Moderate | 16.0 | 4.4 | 795.0 | 0.4 | 7.8 | 0.08 | <1.0 | <0.01 | <0.05 | 7.7 | 0 | ** |
| Carico Springs | SE section springs | 3Sp-28 | 4441718 | 509724 | 9/22/99 | 1015 | | * | | | Extreme | Moderate | 13.7 | 6.9 | 838.0 | 0.4 | 8.0 | <0.05 | <1.0 | <0.01 | <0.05 | 13.6 | 510 | ** |
| New Moss Creek Spring | Spring head | 3Sp-29 | 4450576 | 498137 | 9/22/99 | 1225 | | 0.50 (est.) | | | Extreme | Low | 9.3 | 2.6 | 1,095.0 | 0.5 | 7.4 | 0.09 | <1.0 | 0.01 | <0.05 | 1.6 | 0 | ** |

* = Flow too small to estimate

** = Not analyzed

*** = See Water Quality section

Highlighted cells are above (or below for D.O.) standards.

[1] Nevada Division of Environmental Protection: Bureau of Water Quality Planning. Water Quality Regulations. 1998

# APPENDIX C

## SITE DESCRIPTIONS OF SPRINGS AND STREAMS

### Springs

Sp-1= Copper Canyon- Rush, willow, monkey head, and sedges along channel of springs' stream, which was fed by at least two spring heads. Cow usage appeared low due to lack of cattle trails and feces. * No picture.
Sp-2= Hole in the Wall Spring (spring head)- Sample taken from within cave to obtain an uncontaminated sample. (Fecal Test Only)
Sp-3= Hole in the Wall Spring (downstream 15 yards in depression ponds)- Area heavily utilized by cattle. Depression area dammed up to create pond for cattle, which was heavily trampled. Many tubaflex, which look like orange-bloodworms, located throughout pond. Cattails remained in middle of pond. (Fecal Test Only)
Sp-4= Greystone Mine Spring (at bottom of talus pile)- Metals tested directly at spring outlet from talus pile, while other tests were sampled 30 yards below. Moderate cattle usage indicated by cattle prints and feces around the pond and in the stream.
Sp-5= Spring south of Greystone Mine (located by water pump and fencing)- Excessive cattle usage indicated by heavy trampling and feces. Fence around area is completely destroyed. Three ponds are within fencing.
Sp-6= Bridge's Well (sampled directly from electric well pump)- This sample is representative of groundwater for the area. Irrigation occurring from agricultural activity in area may have affect on ground water from leaching through soil.
Sp-7= Bridge's Well (sampled from east pond below pump's trough)- This area is heavily grazed and trampled with barren ground all around ponds. Trampling is also associated with ponds. East pond did not have any algae in it, while the west pond was full of algae. Created for cattle usage.
Sp-8= Cedar's spring (spring head)- Water is piped into a trough, which then flows into a man-made pond and flows out as a stream.
Sp-9= Cedar's spring (sampled from pond outlet)- Area is extremely grazed and trampled. At least 50 head of cattle were spotted at the area. Cattle wade directly in the pond and excrete waste directly in it.
Sp-10= Fish Creek spring (sampled 40 yards south of spring head)- Area appears healthy because of tall poa (about 1-2 feet tall), but it is heavily trampled from cattle.
Sp-11= Old Trough spring, east of Smith Flat (sampled ½ mile downstream of spring heads)- Stream has a thick silty-clayey bed. No riparian vegetation is located along stream. Excessive trampling has led to heavy hummocking throughout area. Dead trampled sage brush along stream.
Sp-11a= Old Trough spring, east of Smith Flat- Spring head area has excessive grazing and trampling over an area of about one-quarter acre. Trampling has caused the stream to increase in width (20 yards) and has also caused small ponds in the area. The edges of the area are being eroded by the cattle, especially around spring heads.
Sp-12= Horse Pasture Spring (at spring head)/ Sp-12a= (10 yards below spring head)- Trampling has caused extreme hummocking which has led to ponding in the area. Spring area is heavily grazed over a quarter acre.
Sp-12b= Horse Pasture Spring (35 yards below spring head, after outlet from pond)- Stream is trampled along total stretch which has led to extreme hummocking.
Sp-13= Southeast corner of allotment (upper seep)/ Sp-14= (lower seep)- Trampling has caused extreme hummocking which has led to ponding in the area. Spring area is heavily grazed over a half acre.

Sp-15= Within Exclusionary Boundary near Elephant Head (taken in lower section of stream at the fence)- Great basin wild rye and poa grass all over the 2 acre excluded area due to no-to-low usage from cattle. Grasses were 1 to 2 feet high. Fences were intact. Stream channel in good shape due to lack of cattle.
Sp-15a= Within Exclusionary Boundary (at spring head)- Water cress located at spring head. Spring head in good shape. *At second sampling (8-31-99), spring head had been grazed recently and the area was still fenced. Deer or wild horses may be grazing area.*
Sp-16= Outside Exclusionary Boundary (taken in lower section of stream, at same distance from spring head as Sp-15)- Streambed destroyed from trampling and grazing by cattle. Channel is seriously disturbed and lacks vegetation.
Sp-16a= Outside Exclusionary Boundary (at spring head)- Trampling has caused excessive hummocking which has led to ponding in the area.
Sp-17= Orange Rock spring (at spring head)- One of many springs located at the head to Moss Creek. Trampling has caused extreme hummocking which has led to ponding at the spring head. Orange fungi are located on rocks near spring and algae in the spring are orange.
Sp-18= Carico springs (northeast section of springs)- 3 acre spring area located on south side of lake. At least 100 head of cattle were seen in area. Grasses are grazed short and some areas are barren. Trampling has caused extreme hummocking, causing ponding throughout the area. The sample was taken from one of the ponds. Many native birds located around springs. Wetland area would be beneficial to wildlife if restored.
Sp-19= Pasture spring (75 yards below spring head)- 2 acre spring area with a number of seeps. Extreme trampling located over large field causing bank cutting and hummocking. Grasses are no taller than 6 inches throughout area. Stream channel is heavily trampled.
*2Sp-19= at second sampling, 6 wild horses were seen in the pasture.*
Sp-20= Pasture spring (spring head)- Trampling and grazing located around spring head. Watercress located in stream and spring area for about 20 yards.
Sp-21= Canyon spring (up in canyon)- Undisturbed by cattle due to inaccessibility of canyon. Great Basin Wild Rye, sedges, rush and poa grass located in canyon. Antelope spotted in canyon.
Sp-22= Wilson springs (stream of springs)- Good shade along channel due to pinyon/juniper overstory. Some riparian vegetation found along stream (e.g. poa, monkey flower, wild rose). Moderately trampled in stream and along banks causing some erosion. More springs located upstream, which were not sampled.
Sp-22a= Wilson spring (eastward spring head)- Extreme trampling and grazing in the area due to cattle. Cattle are also causing bank erosion. Road cuts across spring area.
Sp-22b= Wilson spring (westward spring head)- Spring was not flowing due to trampling from cattle. Water sample taken from hoof print pool. Road cuts across spring area.
Sp-23= Elephant Head spring (downstream from head 40 yards)- Extreme trampling and grazing occurring at spring head and continuing downstream for about 200 yards. Tubaflex were seen in trampling ponds, where the spring was sampled.
Sp-23a= Elephant Head spring (at spring head)- Trampling has caused extreme hummocking which has led to ponding in the area. High turbidity is caused by the heavy grazing.
2Sp-24= Cow Scratch spring (40 yards downstream from heads)- Heavily disturbed aspen stand that has no regeneration. Hummocking and heavy trampling occurring.
2Sp-25= One Horn spring (50 yards downstream from spring heads)- Along road to Elephant Head exclosure. Area is extremely grazed and trampled.

2Sp-26= Beef Bull Yon spring (spring head)- Small pool was dug out at spring head. No vegetation remained within 10 yard circumference of the pool. Down-gradient from pool was extremely trampled and grazed over a 30 yard wide and 50 yard long area.
3Sp-27= Ferris springs- Provides flow to Ferris creek. Area is heavily grazed and trampled, but appears to have enough vegetation to rebound in the following year if it was given a rest from cattle.
3Sp-28= Carico springs (south-east section of springs)- Many springs in the area that are being negatively affected by livestock presence. Trampling is causing severe hummocking throughout entire area.
3Sp-29= New Moss Creek spring- Spring flow is extremely disrupted from hummocking and grazing. Downstream turbidity is significantly affected from cattle.

**Streams**

Ck-1= Elder Creek (Downstream from mine)- Cow trails and cow feces all along stream. Sediments, ranging from gravel to cobbles, are in the streambed. Numerous aquatic worms covering rocks, about 1 cm in length. Algae located in stream.
Ck-2= Elder Creek (Upstream from mine)- Sampled at confluence of small tributary. Sediments, ranging from gravel to cobbles, are in streambed. Banks are becoming eroded from cow usage. Area is heavily trampled. Lots of wild rose located along channel.
Ck-3= Elder Creek (Head waters)- Stream dries up in several places below this sampling location. It is fed by springs on the mountain slopes. This area has heavy cattle usage also, but not as severe as downstream areas.
Ck-4= Ferris Creek (Small section within allotment boundary)- Highly eroded banks and a heavy silt layer on rocks were observed. A flowery alga was found in the stream. A spring just upstream from this location had extremely heavy cattle usage.
Ck-5= Indian Creek (Upstream from Ferris Creek confluence)- Rocky bottom with lots of riparian vegetation. Trampling throughout streambed. Minnows were seen in the creek.
Ck-6= Indian Creek (Downstream at road crossing, west of rt. 305)- Rocky, sandy, and silty bottom seen in the creek. No riparian vegetation observed along banks. Banks appeared very instable. Algae were seen in the creek.
Ck-7= Mill Creek (at rt. 305 crossing)- High human disturbance because of redirected flow.
Ck-8= Reese River (1 mile south of Antelope Road)- Dried up completely from the 4 cfs flow a week earlier. Sample was taken in ponded area. No riparian vegetation seen. Heavily trampled.
Ck-9= Reese River (Gauging station 5 miles south of allotment)- Large cobbles scattered across streambed. Steep banks located along river.
Ck-10= Fish Creek (Upper, at allotment boundary)- Sandy to cobble sediments cover the streambed. Highly eroded banks with cattle trails running all along them. Some monkey flower and bull rush along banks.
Ck-11= Fish Creek (Lower, just above private)- Sampled at an extremely-heavily grazed area which is in horrible condition. The lower section of Fish Creek has no shade along the creek from the lack of vegetation. Man-made channel to direct water through rancher's property.
Ck-12= Wilson Canyon Creek- Steep banks along the creek. The streambed has sandy to cobble bottom with greyish silt deposits covering them (probably from upstream cow usage). Lots of wild rose in channel. Willows present downstream.

Ck-13= Cook's Creek (Upper section)- Cattle trails located all along banks. There were tall-eroded banks upstream and downstream from the sampling location. The streambed consisted of sandy to boulder-size rocks. Lots of algae located in the creek. Some riparian vegetation was seen including bull rush and wild rose. Black filter worms were seen in streambed.
Ck-14= Cook's Creek (Lower section)- Streambed is covered with silt and consists of gravel to cobbles. Algae appear to be dying in creek. Tall-eroded banks are located along creek, along with livestock trails.
Ck-15= Cottonwood Creek (head)- Extremely turbid water is due to the heavy trampling and grazing from cattle around upstream spring heads. Some poa found on banks.
Ck-16= Moss Creek (300 yards below spring heads)- Extremely turbid water is caused by cattle trampling of spring heads. Stream banks are overly grazed and hummocking is occurring in the stream. Silty, sandy streambed is present. Downstream, within canyon, riparian vegetation is located along channel. Livestock are fenced off from this area.
Ck-17= Wenban Creek (lower end)- Heavy silt deposits found on the streambed. Wild rose and poa are located along streambed.
Ck-18= Wenban Creek (2.3 miles upstream)- Silt to cobbles composed the streambed. Wild rose is located along creek.
Ck-19= Elephant Head Stream- Silty streambed. Some cattle trails present, only moderate usage. Bull rush and sedges located along stream.

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